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I. TENERIFFE.

An Ascent of the Peak and Sketch of the Island. Illustrated.

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In this paper it is my intention to record briefly some of my experiences during a residence in the Island of Teneriffe, and I shall describe whatever appeared to me of value, according to my habits of investigation; imperfect as the narrative may be, I hope it will be the means of inducing more capable observers to visit that interesting island, which, on a small scale, offers a very ample field for the labours of the man of science; where the vegetations of most distant regions meet together, and where a climate can be obtained, varying within a few miles from the softest temperature of Italy to the cold of an English March.

In consequence of a very severe affection of the lungs, I was ordered to try the climate of Madeira; on my arrival at that beautiful island, the medical man I consulted told me that the climate of Funchal was not suitable for my complaint, and advised me to try that of Teneriffe, where I could reside during the summer months at a considerable elevation above the sea, and during the winter on the coast, and thus enjoy an equable temperature throughout the year; his advice appeared to me so good, that I resolved to adopt it.

I left Funchal with a strong north-east trade wind, which we expected would enable us to reach Teneriffe in about thirty hours, as the distance is only about 200 miles.

After passing Madeira, we remarked the peculiar change in the colour of the sea, which passed from a cobalt blue to a very deep Prussian blue, probably caused by the increased depth of the ocean and the very blue colour of the sky. I had been told that the lofty cone of the Peak of Teneriffe could be distinctly seen at a distance of 120 miles; about an hour after sunrise we supposed that we were within one-half of that distance, but no Peak was to be seen, to my

Hist. of Science

great disappointment. I found afterwards that it is seldom seen at a great distance during the warmest months of summer, but is very clear and distinct during the cold months, or before rain and immediately after it, when the transparency of the air is greatly increased by a certain quantity of vapour which is held in suspension through the atmosphere. Besides, the upper part of the Peak, or "sugar-loaf," which is the only part covered with whitish-coloured pumice, reflects more light than the sides of the volcano, which are covered with trachytic lava; thus the cone reflects a whitish light, which contrasts with the surrounding sky, and enables it to be seen at a distance, when it subtends an angle sufficiently large to make an impression on the retina. As the Peak may serve to direct the navigator and enable him to verify his position, the exact distance from which it can be seen is of importance. We stood rapidly on our course, and when we approached within twenty miles of the island, we saw the top of the Peak glistening through some breaks in a mass of cumulose clouds; from its extreme whiteness, I thought that the cone was covered with snow, but it was merely the reflected light from the pumice.

In a few hours we came to an anchor off Orotava, on the north side of the island, which is exposed to all the swell caused by the N.E. trade-winds. Such rolling I had never experienced, the vessels occasionally showing almost their keels, or what they had upon their decks. The landing, however, is not bad, as it is sheltered behind numerous pinnacles of volcanic rocks, which break the force of the rollers.

What a new scene presented itself when I put my foot on shore, so different from what I had left in London. Such rich dazzling colours, and such Murillo-looking countenances among the lower orders, set off in a great degree by a glowing mid-day sun. The graceful and picturesque dress of the peasantry was particularly striking to a new-comer; the women wear no bonnets, but a half-square of white kerseymere or cashmere, or fine flannel trimmed with white satin ribbon with rosettes at the corners, is thrown over the back of the head; unfortunately, its neatness is spoilt by an odious steeple-crowned black hat, similar to that worn by women in parts of Wales. Their hair, which is always attended to with great care, is drawn tightly over the forehead, made as smooth as possible, and occasionally collected at the back into one or two tails, and most have a small round curl fixed close to the temples. Their tall figures and graceful movements are set off by their pretty feet, which are clothed, when they go to church, with silk stockings and coloured satin shoes. The ladies follow the Paris fashions, with the addition, when they go out, of the graceful mantilla of black lace, which hangs loose down on the figure, and that regular accompaniment of the Spanish belle, the expressive fan, the dexterous management of which is quite an accomplishment of a lady of fashion.

The dress of the male peasantry is picturesque: it consists of a cloth jacket, a showy waistcoat embroidered at the back, velveteen breeches open at the knees, ornamented with a number of buttons; when travelling their jacket is generally dispensed with; their well-made legs are covered with long leather gaiters ornamented with coloured leather; a straw hat shadows their generally fine features: altogether they present models of fine masculine forms capable of enduring great fatigue. This pretty and suitable dress is, however, spoilt in a great degree by wearing over it, even in the hottest day, an English blanket made into a sort of cloak formed by a running string round the neck. It is said, that this part of their dress was used by the Guanches, the ancient inhabitants of the island.

When I landed at Port Orotava in the begining of July, the thermometer in the shade ranged during the day from 73° to 77°, a temperature which I found relaxing, therefore I was anxious to remove to the romantically situated Villa de Orotava, three miles off and 1,141 feet above the port, with a temperature several degrees lower. But there was a serious obstacle to my intended residence at the Villa, as at that time both hotels and lodgings were unknown; however, I obtained a letter of introduction to the prior of the Augustine convent there, who possibly might give me (although a heretic) the use of a cell in his large, but thinly filled convent. Armed with my letter, I called on the worthy prior; on presenting it to him, I addressed him a few words in indifferent Spanish, but I was soon very agreeably surprised by being seized warmly by the hand and answered in a rich Hibernian accent, "How glad I am to see a countryman here." He kindly offered me a choice of cells, but in doing that, he added, "I can only offer you the bare walls and the use of our cook as long as you think proper to reside among us." I soon sent up the necessary furniture, and passed twelve months most agreeably with the warm-hearted prior and his friars.

The career of the prior was not a common one; he had passed his youth as an officer in the British army, and had served during the whole of the Peninsular war; having become tired of the ennui of his half-pay inactivity in Ireland, he went to pay a visit to his old friends in Spain, where he was persuaded to take the friar's cowl, and afterwards became a prior of the Augustine convent of the Villa de Orotava.

I can testify feelingly to the superiority of the climate of Teneriffe to that of any European district for all affections of the lungs. When I left England I had all the bad symptoms of pulmonary consumption, brought on by a neglected cough, yet in a very short time, without any medicine, they all disappeared. As a proof of what climate did for me, I will mention that three months after my arrival I made an attempt to ascend the Peak, but was obliged to return when within a few hundred feet of the top, in consequence of my men refusing to go any higher. I do not wish it to be supposed that the climate will *cure* consumption, or where tubercular disease has occupied a considerable portion of the lungs, which it had not in my case; but its warm, dry, equable temperature, which can be obtained throughout the year by varying the altitude, is a most powerful remedial agent, and will do more to ward off that sad malady than any other part of the world, excepting possibly the city of Mendoza, on the eastern foot of the Andes, in the republic of Rio de la Plata. A scientific French gentleman who had observed the temperature of the Villa de Orotava during some years, informed me that his self-registering thermometer had never been below 12·5 C. = 54·5 F.: during the winter I passed there I never saw it below 55·5 F. The following is the mean temperature of Santa Cruz, the principal port and town on the south side of the island; San Christobal de la Laguna, the capital, 1,740 feet above the sea; and the upper part of the Villa de Orotava, 1,121 feet above the sea.

	Santa Cruz.	Laguna.	Villa de Orotava.	
March . .	67·10	58	62·75	
April . .	67·25	58·75	63	
May . . .	72·10	62	67	
Mean .	68·81	59·58	64·25	Spring.
June . . .	73·85	64·87	68·87	
July . . .	77·25	69·12	70·12	
August . .	78·85	70·85	73·88	
Mean .	76·65	68·28	70·95	Summer.
September .	77·25	70	72·90	
October . .	74·64	66	70·40	
November .	70·40	61·87	65·85	
Mean .	74·09	65·95	69·71	Autumn.
December .	65·81	58	62·15	
January . .	63·80	54·75	59·25	
February .	64·34	56	60	
Mean .	64·65	56·25	60·40	Winter.

Mean Annual Temperature of Santa Cruz . . 70·05
" " Laguna . . . 62·51
" " Orotava . . 66·34

It will be seen from the preceding table, that the summer warmth is prolonged to the month of November, which month is 3°·15 warmer at Santa Cruz than April. Penzance is the mildest part of England, there the mean temperature of November is only 45° or 25°·40 below that of Santa Cruz.

The houses of the nobility and gentry are built after the Moorish style, which is pre-eminently suitable to warm climates; they form a hollow square which is frequently filled with orange trees, oleanders with their rose-pink flowers, or bananas whose delicately green leaves throw around a delicious shade. The lower part of the houses contains stores for wine, &c., or offices; above is an open balcony leading to the reception rooms and bed chambers; the whole crowned by a high square tower ("mirador") with a flat roof: those of the Villa de Orotava overlook two extinct volcanoes, an enchanting valley under a high state of cultivation, bearing the vine, oranges, lemons, and various tropical fruits, with the sea in front, bounded on the west by an almost vertical cliff, or crater flank, called Tigayga, above which are various mountains, from 9,000 to 10,000 feet high, crowned over all by the white cone of the majestic Peak, towering to the elevation of 12,200 feet. These flat-roofed towers are a great source of enjoyment to the gentlemen of the island, who assemble on them in the cool of the evening, to chat, smoke their cigars, and sometimes to have rival games of flying kites, of which they are extremely fond.

Vegetation assumes here her fairest forms; the south side of the island is in most parts arid and burnt up, but on the north side it is adorned with many of the vegetable forms which add so much beauty to the tropical regions. From the elevated plains of pumice, called the "cumbre," which crown the top of the entire island at an elevation of about 6,000 feet above the sea, one may plainly distinguish five distinct zones of vegetation, which are as marked as if they had been planted by the hand of man.

The first region, which may be termed that of the vines, extends nearly 1,500 feet above the sea, and although you occasionally find vines 500 or 600 feet higher, yet the grapes are not considered fit for making wine. In this region are found all the fruits of Southern Europe: date-palm, *Papaya*, *Banana*, sugar-cane, the various tribes of *Cucurbitæ;* in the botanical garden near Orotava there is the coffee-tree, cinnamon-tree (*Laurus cinnamomum*), and the bread-fruit tree (*Artocarpus incisa*): the *Arum Colocasia* is very common, it produces a species of arrowroot; the *Palma Christi*, or castor-oil plant, and the Spanish carnation (*Poinciana pulcherrima*) are hedge-weeds. Some of the arborescent Euphorbiæ are peculiar: the *Euphorbia Canariensis* is in bushes ten to twelve feet high and twenty in diameter; it is found at various elevations, but it thrives best below 2,000 feet; when this plant is wounded, it exudes a white milky juice, which is very acrid and caustic; when inspissated it is employed instead of cantharides by the natives, formerly it was used considerably in England as a cathartic, emetic, errhine, and rubefacient when properly diluted, but its internal use is now discontinued in medicine. At the upper part of this zone, immense plants of the *Cacalia Kleinii* thrive with much luxuriance. That extraordinary tree the dragon tree (*Dracæna draco*) grows only in this zone; it produces a fine scarlet gum, called by the old Arabian physicians "dragon's blood." In a garden in the Villa de Orotava is a renowned dragon tree, supposed to be many thousand years old: when the Spaniards arrived at Orotava in 1493 the trunk was then hollow. It is about 60 feet high and 49 in circumference near the ground, and 35½ feet at 6 feet from the surface. Humboldt made it only 45 feet in circumference, but he must have measured it higher up; I once cleared the ground round the trunk and found it 49½ feet. Many years ago a large arm was blown down by a storm; the present proprietor has very properly taken measures to preserve the tree, by supporting it with props and masonry.

During many centuries this zone gave employment to the greatest part of the population of the island in the cultivation of the vine, but some years ago the grapes became diseased, which produced much distress among the poor; fortunately, they took to cultivating the cochineal insect on the *Cactus cochinellifera* and *Opuntia vulgaris.* It was raised with great success on the south side of the island, whose arid and parched surface appeared at first to be particularly favourable to it, as it yielded occasionally a profit of 45*l.* per acre; but it proved a very precarious industry, for although the female insect prefers a high temperature, yet it is killed by a high radiation. Fortunately, the vines have recovered from their disease, and the cochineal trade has fallen off in importance.

The second zone of plants, extending from 2,000 to 3,400 feet above the sea, may be properly called the region of laurels; by the natives it is termed "Alta Verde,"—Green Mount. This region exhibits thick woods of Canarian oak (*Quercus Canariensis*), *Laurus nobilis, L. indica,* and *L. fœtens,* two sorts of chestnut trees, a wild olive (*Olea excelsa*), some heaths, such as the *Erica arborea* and *E. scoparia;* masses of daphne, yellow St. John's wort, some species of the *Sideroxylon*, several trees of the myrtle species, round which was entwined the Canarian ivy (*Hedera Canariensis*). There is found in great abundance in this zone, as well as at an elevation of more than 9,000 feet, a very beautiful leguminous plant, called by the natives "Codeso" (*Codonocarpus frankenoides*); it has composite leaves of a light-green colour, a woody stem, and branches out like a tree; it makes an excellent fire for the traveller, and when burnt, gives out a strong aromatic smell. In the lower part of the zone are large bushes of two or three species of Hypericums, but only one (the *H. Canariense*) is indigenous; this luxuriant plant is found also in the lower zone. The Campanula and Chrysanthemum show themselves wherever the ground of this zone is covered with moss.

The third zone, which is generally enveloped in clouds towards the evening, extends to 5,400 feet above the sea. It may be considered as the true region of the arborescent ferns and that beautiful and useful tree, the Canarian pine, which will be in a few years swept away by the woodman's axe. Where this has been done on the north-west side of the island, they have, as might have been expected, suffered much from drought. The pine is mingled with a juniper tree, called the *Juniperus oxycedrus,* and wherever there was a spring of water, it was surrounded by seven or eight species of ferns, but only two of them were peculiar to the island,—the *Asplenium Canariense* and the *Trichomanes Canariense;* the Arbutus is very luxuriant, but it flourishes equally well in the upper part of the second zone.

The fourth zone may be said to extend to the elevation of 7,000 feet; in this division, the vegetation is much mixed with that of the upper part of the lower zone, such as the Canarian pine, juniper, and large flowery bushes of *Retama*, the Spanish name for two species of mountain broom (*Spartium monospermum* and *Spartium nubigenum*).

The fifth and upper zone consists of plains of pumice, whose parched and barren aspect is only occasionally relieved by detached bushes of *Retama* and "*Codeso,*" whose dry and pale-green leaves gain a scanty nourishment amid the scorching heat of the sun. Even at the foot of the Peak, at an elevation of 8,957 feet, with a radiation sometimes of 180°, and a depression of 54° of the wet-bulb thermometer, a lilac-coloured violet is found (*Viola cheiranthefolia*), and the *Scrophularia glabiata* and some lichens on the Peak near the Ice Cave, at an elevation of 11,098 feet.

When I mention these different zones, or bands of vegetation, it must not be thought that they appear so very distinct as you pass through them, as in fact they are much blended, particularly at the verge of every zone. As I was in the habit of passing through three of the belts of vegetation three or four times a week, I paid great attention to their lines of demarcation, which I endeavoured to ascertain in the following manner: I ascended some commanding position, and noted the peculiar vegetation from one salient point to another, as far as I could see, which I measured afterwards with a barometer. At first, I attempted to measure the elevation above the sea of the last tree in every zone, but it was attended with so many difficulties that I abandoned the plan.

In the "Cumbre," or plains of pumice, which are at an elevation of from 6,500 feet to the foot of the Peak, which is 7,817 feet, are several caves in the lower cliffs, containing bodies of the Guanches, or aborigines of Teneriffe. They were preserved in a manner very similar to that adopted by the ancient Egyptians. The internal cavities were filled with odoriferous gums, and the body was enveloped in the skins of goats, which had preserved in some degree their suppleness. Round the necks of some bodies I found in a cave in the Cañadas del Pico, 7,700 feet above the sea, were necklaces composed of small discs of baked clay, of different degrees of thickness. The necklaces are very similar in size and material to those I have seen round the necks of the preserved bodies of the ancient Indians of Peru, who employed them as numerical signs, and to record dates and events. One round the neck of a body discovered near Arica, in Peru, was almost identical with those I have seen round the necks of the embalmed Guanches.

The history of the Guanches is involved in the greatest obscurity; probably, they were a branch of the great Lybian stock. Plutarch calls the Canaries the Fortunate Isles, and it is conjectured that they were the site of the fabulous gardens of the Hesperides. Although the Canaries were visited by the Phœnicians, they were lost to the world for nearly fourteen centuries, from the time of Juba, a few years before the birth of Christ, till the year 1330, when a French ship was driven on one of the islands. From that time various expeditions attempted their conquest; the principal one was headed by Jean de Bethencourt, a Norman noble, who landed in 1400, but was ultimately obliged to retire. The Spaniards ultimately reduced Teneriffe and the other islands in 1493. At the time of the conquest, the island was governed by seven independent chiefs, whose manners and customs differed considerably, although their domains were only separated by walls of loose stones. About a century after the conquest, this singular people became utterly extinct. It is said that numbers retired to caves in the mountains, and starved themselves to death, but there is no doubt that disease and misery caused them to melt rapidly away. In the library of the convent where I was residing, there was a manuscript journal, which had been kept by a friar who had attended the last expedition of the Spaniards; it gives a most interesting and affecting account of the extreme humanity and bravery of the poor islanders.

Birds are in great variety; but I must not omit to mention the far-famed canary-bird (*Fringilla Canaria*); when I saw it first in its native woods, I could scarcely recognize it as the same species as our domestic yellow warbler, so much is the latter altered by domestication and repeated crosses. The native bird is grey on the wings, the belly is green, and the back a very dark grey; it builds on bushy trees or high shrubs; the nest is composed of moss, roots, feathers, &c.; it lays from four to six pale-blue eggs, and sometimes hatches six times in a season. It pairs in February, and moults in August and September. I was surprised to find that each flock has a different song; at first I thought that I had been mistaken, but the natives confirmed my observation. The note is between that of the skylark and nightingale. The natives assert that it is very difficult to rear, and generally dies in a couple of years if kept in a cage, though they do not appear to suffer from confinement, as they commence singing directly they are caged.

There is another indigenous linnet (*Fringilla teydensis*) which I have seen at the foot of the Peak; the tinto negro is said to be peculiar to the island, but it is found also in the island of Madeira. Hawks, kites, the red-legged partridge, and other species of Tetraonidæ are numerous.

The fish are of considerable variety. From its peculiar position the island is visited by many migratory shoals, and its fauna thus combines all the fishes of the coast of Africa, of the Mediterranean, and of the West Indies. The bream is found in large numbers between the coast of Africa and the Canaries, and when salted forms a considerable article of export. The tunny is of large size, and is esteemed when pickled. Some varieties of the *Cephalopoda*, particularly the *Octopus*, are eaten by the lower orders, and considered a luxury. Another sort, commonly known as the rock-squid, has a body not larger than a man's fist, yet its arms are four feet long.

As soon as I was strong enough to support much fatigue, I determined to visit the top of the Peak, or "Teyde," as the natives formerly called it. My native friends begged me not to make the attempt, as the cold at that time of the year would be insupportable. But I considered such an opinion erroneous; I had made repeated excursions on foot to an elevation of nearly 7,000 feet above the sea, and once to 8,000 feet, when I suffered more from enormous radiation than from cold. In September the temperature in the shade, at 8,000 feet, was 40° F., while the black-bulb thermometer rose to 196°, or close to boiling point at that elevation.

The inhabitants are supplied with ice (or rather snow) by men who go up to the foot of the Peak for it during the winter months; and in the summer, to the Cueva de Hielo, *ice-cave*, which is 3,281 feet higher up. From the nature of their employment, I thought they would be the best men to accompany me, therefore I engaged the head man and his sons. We got up without danger to the Cueva de Hielo, when they refused to proceed any farther, under the plea that we could not pass the night on the snow without a tent or any extra clothing, therefore I was reluctantly obliged to return.

In February, I agreed with a couple of men to accompany me to the top of the Peak, under an agreement that they were to receive no pay if they turned back against my orders.

The usual plan of those who ascend the Peak, is to leave Port Orotava about one o'clock in the day, to enable them to reach the *Estancia de los Ingleses*, where they pass the night under the shelter of some rock, and then to resume the ascent sufficiently early to see the sun rise from the top of the Peak. As I wished to pass some time at the Estancia to examine the surrounding lavas, and to observe the decrement of temperature from the coast, the Villa de Orotava, and my point of observation, I left the Villa at 4 A.M., at which hour the thermometer stood at 56°·5, the wet-bulb thermometer 53°, and the barometer 28°·78, equal to 30 inches reduced to the level of the sea.

Soon after we left the upper part of the town, we entered the Camino de Chasna, which is dignified by the name of a road, although, like almost all the highways in the island, it is only a steep and rugged surface of lava. My muleteer, guide, and myself moved along in Indian file, and, as we proceeded upwards, the cold gradually increased, particularly after we passed over the crest of the first range of hills which bounds the valley of Orotava. The valleys, and high up some of the mountains where there was vegetation, were covered with dense vapour, but it did not at that hour extend to where we were ascending; above was the intensely blue starry vault of heaven, and in front the clear outline of the Peak covered with snow, looking down upon us in majestic grandeur. There was a peculiar wildness in the scene, which for a time was enlivened by the rather melodious chant of my two men, but towards break of day they appeared tired, and notwithstanding the cold, I found much difficulty in keeping my eyes open; indeed, my men said that I had been dozing, which was very probable, as I had not been to bed the previous night, that I might be ready to start in good time.

About 7 A.M. we crossed the barranca, or ravine, of Pilloni, and that of Pino Dornajito, which is 3,410 feet above the level of the sea; it is so named from an enormous Canarian pine-tree that grew near the western side of the ravine. It is said that this tree was full-grown at the time of the conquest; after having stood the storms of so many ages, it was at last swept into the ravine by the dreadful waterspout that devastated the northern part of the island on the night of the 7th November, 1826; this tree, though partly destroyed, still measured when I saw it, 128 feet in length and 30 feet in circumference.

Under a precipice in the middle of the ravine, is a small spring of water, and a wooden cross at the side of it; the temperature of the spring was 56°, that of the air 40°, and the wet-bulb thermometer 39°·5. At the time of the waterspout a body of water, some hundred feet wide and thirty to forty deep, fell over this spring and cross without doing the least damage, which the peasantry attribute to the merits of the cross, forgetting that the water in falling over the precipice would form a curve, and thus could not touch the vertical wall below.

From the great depth of this ravine, the various rocks that form its perpendicular sides can be observed, as they form a perfect section; the uppermost rock consists of decomposed phonolite, below rough trachytic lava, with vegetable mould to the depth of three feet; next is a sort of volcanic breccia or conglomerate, held together by a brown mud, and afterwards, beds of yellow and grey tufa four to five feet in thickness, succeeded by various alternate layers of dark trachy-dolerite and brown mud. As it was impossible to examine this interesting ravine on my journey up the Peak, I afterwards occupied myself several days in making a plan of it, and taking specimens of all the various rocks along a distance of several miles.

The hygrometric state of the atmosphere showed that we were approaching the lower region of the clouds, the temperature fell rapidly, and the wet-bulb thermometer showed absolute saturation, at the same time vegetation became so luxuriant, that it was difficult to observe the nature of the lavas.

The tree-heaths were of considerable size, some were 18 feet high, with stems nearly 30 inches in circumference; they were mixed with laurels, cystus, and various other arborescent shrubs. It is worthy of remark, that the leaves were of a uniformly dark-green colour. The luxuriant vegetation of this zone is no doubt owing to its greater humidity, as the clouds generally remain at this elevation during the night and the early part of the morning. As we advance to the upper verge of this zone, the air contains less moisture, the radiation becomes much greater, and the vegetation less luxuriant, with the leaves of a light-green instead of a dark-green colour.

The lavas appeared to have flowed in numerous streams from different openings, and their appearance varied considerably according to the angle they flowed over; for instance, where it had run up a slight ascent, it was twisted and contorted, as if it had been less viscous, showing that the surface had become refrigerated. I took specimens of some of the lower streams which were of trachyte, containing pyroxene, hornblende, and mica; over them were other streams, of what may be termed a dolerite lava, it contained crystals of red, brown, and greenish colours, apparently labradorite, and pyroxene: some of the other streams contained crystals found in both kinds of lava, coupled with hornblende and olivine (peridote); they may be fairly called, I think, a sort of trachy-dolerite; they were all highly magnetic. Many of the lavas were much decomposed, with the pores on the surface free from crystals, which had no doubt fallen out, as I always found them internally.

We kept gradually ascending; in crossing the Barranca Haya, we were rather annoyed by the vapour of the clouds condensing in our clothes and hair, producing to our feelings a degree of cold much greater than the 39°·5 indicated by our thermometer; the wet-bulb thermometer proved that the atmosphere was saturated with moisture. The sensible cold was increased by a strong local current of wind from the west-by-south, although the wind below and above was blowing from N.N.W.

At a quarter to eight A.M. we entered the Llanos de Gaspar (the plains of Gaspar), and left the clouds considerably below us; here the vegetation became very scanty; almost the only plants on the surface were patches of Canarian thyme. This desolate spot was, however, particularly interesting, as it was evident that a considerable part of the waterspout which did so much damage in November, 1826, had burst here, cutting the surface into a vast number of ravines, some of them of great depth. From the appearance of the surface, the columns of water which fell must have been very numerous, as in ten or twelve different places the lava was cut into deep trenches, some fifteen and twenty feet deep, with the soil which had been between completely washed away; many of these channels frequently conveyed into one, which formed at last a destructive and overwhelming ravine, in some places 75 feet deep and a quarter of a mile wide; the body of water swept away part of the town of Garrachica in the valley of Orotava, numerous houses and vineyards, with a battery and its guns at the Port Orotava. When I saw the ravine, which had been cut through numerous layers of compact lava, I thought it had been the work of ages instead of only part of a single night.

At half-past nine A.M. we entered the last zone of vegetation, the surface was covered with white lapilli, and protruding masses of trachyte and porphyritic lava, occasionally mixed with pumice. The vegetation for some time had been gradually becoming less luxuriant and more scanty, till here it was reduced to the *Codeso*, and large tufts of mountain broom. The dry, close, and ligneous formation of its leaves enables it to support the immense difference of climate it has to undergo every four-and-twenty hours. During the summer season, in the daytime, the intensity of solar radiation is almost insupportable, for it is sometimes as high as 210° F.; on the contrary, the nights are extremely cold; the dryness is excessive, as I have observed the dew point as great as 45° to 50°, and to rise again in a few minutes to 24° from a passing cloud.

At ten o'clock we came in view of the foot of the Peak, but I was much disappointed when I was informed that we had still a two hours' climb before we could arrive at the foot of that part of it where the ascent was to commence. The view on our right was a novelty to a person who had not been accustomed to ascend great elevations. The valleys below were filled with vapours, whilst over the sea and the regions above were quite clear. Objects below were unusually refracted; two brigantines, which were at a considerable distance, presented inverted images of some of their parts; but what was very singular, they appeared to alter their form as I changed my position; sometimes the masts and vessel appeared as if they were separated, then the masts touched each other, and afterwards rapidly increased in length, presenting quite a distorted appearance. After we had ascended a short distance, this refraction or *mirage* went off, and the vessels assumed their natural appearance.

The Cañadas del Pico (see Plate I.) is an immense plain of an ancient crater, covered with yellow and white pumice, extending round the Peak from W.S.W. to E. by N., forming part of an ellipsis 8 miles by 7, or 23 miles in circumference. The surface near the foot of the Peak is 8,957 feet above the level of the sea; rather towards one side of this plain or crater, in latitude 28° 17′ N., and longitude 16° 39′ 45″ W., rises the Peak to a further elevation of 3,243 feet, or 12,200 feet above the level of the sea.

This plain is surrounded by nearly vertical walls of lava, which would debar all possible entrance if they had not been broken across in some places by a great convulsion of nature; the one by which we entered is very aptly named by the natives *El Pertillo*, the little gateway. The surface is dotted over with masses of reddish coloured and black trachyte and phonolite, which apparently are erratic masses, but on close inspection, it can be seen in many places that they are in some degree circular, and are very probably the tops of extinct craters, or rents of more modern date than the great plain or crater. These Cañadas form the only road of communication between the northern and southern parts of the island, but during the winter season they are sometimes impassable from the great depth of snow.

We passed a small extinct volcano, called Montaña Negra (*black mountain*), but more generally known by the name of Los Gorros; in it are several caves, which are used as ice-houses by the men who supply Santa Cruz and the other towns with snow; they collect it at the foot of the Peak at certain seasons of the year; when they cannot obtain it there, they go up to the Cueva de Hielo, which is 2,131 feet higher up, or 11,098 feet above the level of the sea.

At mid-day we arrived at the foot of the Peak, where we left our mules with some fodder we brought up for them. We remained there an hour to breakfast and to enable me to make the following observations:—

	In.
The Barometer stood at	20,654
Thermometer in the shade	44° F.
Wet-bulb Thermometer . . .	4
Black ditto	140
Boiling point of water	196·7

I am not certain that this is perfectly correct, as it varied from 196°·4 to 196°·7, the bulb of the thermometer was not plunged into the water, but in the steam about an inch above the surface of the water.

We began to mount the Peak on foot, by a very steep ascent over a surface covered with yellowish coloured pumice, between two embankments or currents of trachytic lava, which had separated in cooling from the general mass called Mal Pais, situated at Alta Vesta de Arriba 10,621 feet above the sea. It is not quite correct to call them currents; although in continuous lines, the lava was not in connected masses, but in large detached blocks of various sizes and forms, that had apparently undergone various degrees of rapid and slow cooling; the most common description was a trachy-dolerite, with more or less felspathic minerals; some were obsidian, or volcanic glass, of a jet-black colour, having internally a shining vitreous lustre, breaking with a conchoidal fracture, and translucent at the edges. It is worthy of remark, that when I broke some specimens from the lowest part of a mass of obsidian they contained crystals of felspar, but in the upper part of the same mass, very frequently I could not discover a single crystal, as if they had fallen down to the bottom, when the mass was liquid, by their own specific gravity. On breaking some of them, they exhibited cavities containing an incipient crystallization forming concentric laminæ of a lighter colour than the rest. In some places I picked up pieces which were slightly convoluted, containing small crystals of pyroxene and glassy felspar.

Another singular circumstance is, that the pumice taken from the Cañadas of the Peak is heavier and contains more silica and alumina, and less potash and soda, than that on the sides and top of the Peak; the latter contained about the same quantity of silica and alumina as the trachy-dolerite.

The following is the analysis made for me by the late Dr. Andrew Ure:—

	Silica.	Alumina.	Potash.	Soda.
Trachy-dolerite, from the Peak .	57	16 95	1·14	6·40
Pumice, ditto	59·87	15·89	10·20	3·15
Ditto Cañadas	62·40	14·97	6·25	1·96

It will be seen that all this pumice contains a smaller amount of silica than that from the Lipari Isles, which according to Klaproth contains 77·50 of silica and 17·50 of alumina.

Some of the blocks of lava I examined higher up the Peak had more of a porphyritic than a trachytic character, as they contained blotches of crystals of a greenish and greyish-white colour, which I mistook for ordinary felspar; but I was informed on good authority that they were pyroxene, labradorite, and chrysolite, therefore the blocks may be more properly considered a species of basalt, though they had all the spongy and rough appearance of a trachyte. Occasionally there were detached blocks of phonolite, of a greyish-blue colour, containing much felspar and mesotype; it made a smooth fracture, and had the peculiar metallic sound of that rock when struck with a hammer.

After a very fatiguing but not difficult ascent, which took us an hour, including the time occupied in examining the lavas, we arrived at a part of the Peak called *La Estancia de los Ingleses de Abaxo* (the lower halting place of the English), which is 9,930 feet above the level of the sea. The pumice here forms a tolerably level surface of a few hundred feet square; towards the N.N.E. side of it are some large scattered blocks of obsidian, under the lee of one of them we piled up some pieces of lava to form a slight shelter from the wind, which was extremely cold, and blew such a gale that we were frequently obliged to hold on to the rocks to avoid being blown away, and which for some time made all our efforts useless to light a fire of mountain broom.

At sunset it suddenly abated, and two hours after there was a calm, occasionally interrupted by violent gusts of wind, which rushed along with a noise like distant thunder in a mountainous country.

After partaking of a supper of hot coffee, bread, and roasted potatoes, we made a trench in the pumice, in which I placed my guide and muleteer, and then covered them up to the neck with light pumice-dust, over which I put my cloak. This simple plan so effectually protected them from the bitter cold, that I soon found they had forgotten all the fatigues in a sound slumber.

As I wished to note the barometer and thermometer every hour, and had agreed with some friends at Port Orotava and the Villa, to observe them at the same time during part of the twenty-four hours, I was unable to take the rest which I so much required. The strange and interesting scene around me caused a feeling which partook in some degree of pleasure and pain; not having anyone to whom I could express my feelings, produced a painful void. The peculiar wildness of the scene was in some degree enlivened by the splendour of the starry vault above, which was so extremely blue, that if it had been seen in a picture, it might have been thought unnatural. From the clearness of the atmosphere, the light given by the stars and planets was sufficient to enable me to write my observations, and Venus left a faint glimmering streak of light on a wreath of snow close to our resting-place; and when the moon arose, I could distinctly see the degrees on my instruments. A still stronger proof of the extreme clearness of the atmosphere was, that I observed the moon to be indented like a saw, between the light and obscured part, which I supposed was caused by the projection of the illuminated tops of the mountains upon the part which was deprived of the sun's light.

Soon after dark a broad pyramidal body of light appeared, like the glow on the sky caused by a distant conflagration; this was the zodiacal light; where there were openings in the clouds below, the brightness continued close down to the horizon, with as deep a tone as that of the zenith. It was much broader below, occupying a space equal to what I considered to be nearly 15° in breadth. Orion was so clear, that if I had had a telescope of even moderate power, no doubt I might have seen the whole of his sword.

Another phenomenon I observed may be worth mentioning. Soon after the sun went down, the wind became much louder and had an acuter sound, although the force was very considerably less than it was before. It has been observed, from the earliest antiquity, that the air becomes more sonorous at night than in the day, but I am not aware that the cause of it has been well ascertained. The general opinion is, I believe, that the air, becoming colder, is therefore denser, and more susceptible of conveying the sonorous waves. Our navigators to the North Pole have frequently mentioned the surprising distance from which they were enabled to hear sound during an Arctic winter. My observations of the intensity of sound at different states of the atmosphere were not confined to the Peak. At the town of Orotava, situated about two miles from the sea, the noise of the waves in the morning occasionally had a grave, low tone; at the same time, the air appeared to be particularly *dry*, and distant objects were very indistinct. Towards the middle of the day, or the beginning of the afternoon, and when the difference between the dry and wet bulb thermometer was *less* than usual, the island of Palma, nearly sixty miles distant, could be distinctly seen, and the mountains that surround the valley of Orotava were brought apparently so close, that the vegetation upon them could be observed; at the same time, the sound of the sea invariably passed from a grave to an acute sound. The natives prognosticate rain when they observe this particular clearness of the atmosphere, and generally I have found them correct. I have made the same remark during my long residence in Chili, where the distant Andes are apparently only a few miles off shortly before rain, and the noise of the waves of the sea, dashing on the rocky coast, assumes a different tone.

From frequent observations that I have made, I am inclined to attribute the intensity of sound at night to a certain increase of moisture, and to an *equability* of temperature in the different strata of the atmosphere. The increased intensity of sound when I was on the Peak during the night could not have been caused by an increased density of the atmosphere, because, instead of becoming colder, it was four or five degrees warmer when the sound of the wind became more sonorous.

The instruments were observed every hour, and the boiling-point of water was noted four times, giving an average of 193°·64; the barometer, an average pressure of 20°·329. This boiling-point does not exactly agree with the experiments of General Roy, who considered that the boiling-point of water varied 0·88 of a degree for every half-inch of a variation of the barometer At the Villa de Orotava, at an elevation of 1,141 feet, I found the average boiling-point to be 209°·178,—the thermometer was not in the water, but close above it. In the subjoined table I merely give the result of my observations at such times as there were notable differences. The difference of radiation was most astonishing: as night approached it fell 80° in an hour; at midnight it was negative, that is, the shaded thermometer was 9° *higher* than the exposed one. At first I thought it must be caused by local position, but I removed the thermometers three times, and found the results similar. I was surprised to find that, at the moment of sunrise, it was still negative, the shaded thermometer standing 4° higher than the other. At Alta Vista de Arriba, one hour and a half after sunrise, the black-bulb thermometer rose to 98°, and later to 126°.

The following table is the result of my observations made at La Estancia de los Ingleses, 9,930 feet above the level of the sea:—

Hour.	Sheltered Thermometer.	Black-bulb Thermometer.	Dew-point Depression.	Boiling-point of Water.	Barometer.
1.0 P.M.	50	195	46	193·65	20·334
3.30 „	42	190	45	193·62	20·330
7.0 „	36	39	40	193·61	20·327
Midnight.	38·5	29·5	31	—	20·324
2.0 A.M.	38·5	27 5	30	—	20·323
5.0 „	36·5	32·5	35	—	20 331
Noon.	66	212	60	193·68	20·336

About an hour before sunrise I awoke my sleepy men, but my guide (who had never ascended to the top of the Peak) was seized with an affection like sea-sickness, and a violent pain in the head, no doubt caused by the rarity of the air, therefore I was obliged to leave him at the Estancia to await my return.

In an hour we reached that part of the Peak directly above Alta Vista de Arriba, called Mal Pais (bad country), 10,730 feet above the sea. The part we arrived at was well named Mal Pais, as it was formed of immense masses of trachytic lava, thrown about in all imaginable shapes and directions, interspersed with large blocks of obsidian, some of which were like enormous bombshells; one or two small ones that I broke were hollow in the centre; the internal cavity was lined with thin filaments, similar to those found in flint nodules; the edges of some of the masses of obsidian were often as sharp as those of broken wine-bottles. The blocks of lava were sometimes wide apart, and sometimes had mere slits between them, but always wide enough to swallow up a pencil if one were dropped in. Some of the lavas looked as if they had run down the Peak in a half-fluid state, and had broken into detached masses in cooling.

We had made our ascent up to this point by the lights of the spangled vault above, but it was impossible to proceed any further until daylight. We had not long to wait; in a few minutes a long and bright streak of light orange-colour began to tinge the eastern part of the fleecy clouds below; it then deepened into a rose-colour, which was reflected on the cone of the Peak just above us, and then followed such a magnificent blending of colours as to defy description, and the day-break rapidly chased away the darkness in the plain below. The cold was most penetrating; the thermometer stood at 21°, which was 13° below what it had stood at, at any time during the night, only 800 feet below.

We again resumed our ascent, which over these rough masses was difficult and painful, as we were obliged to jump from block to block, aided by a long staff shod with steel, and occasionally to climb over some with the hands and feet. The greatest annoyance we experienced was from thick masses of snow between the blocks of lava, which had frozen hard, forming a surface like glass, thus making it extremely difficult to cross, particularly as I was unprovided with proper shoes. The thermometer soon rose to 34°; this sudden rise of temperature, combined with the great exertion of climbing, made me feel my overcoat oppressive, and I was glad to leave it, till my return, under a high block of obsidian. After some fatigue, we reached a spot called the Cueva de Nieve (*the cave of snow*), which is 11,098 feet above the level of the sea. At 7 A.M. the thermometer stood here at 42°·75, the barometer at 19°·912, and water boiled at 192°·78.

This singular cave is always filled with ice and water; the entrance is merely a hole in the trachytic lava, about 40 inches square, and from 18 to 20 feet perpendicular depth; as I was not provided with a ladder, my man let me down by fastening a rope round my waist. I found the floor immediately below the entrance was formed of rough blocks of lava; there were three branches or lanes, the principal one, which I more particularly observed, was 60 to 70 feet long. Round the walls was a band of ice about 7 feet wide and 3 feet high, completely surrounding a little pond of water which did not exceed 2 to 3 feet deep near the mouth, but at the farther extremity I could not reach the bottom with my mountain staff, 8 feet long. At the farther extremity was what the *neveros* (ice collectors) call El hombre de nieve, the man of snow; on close inspection it proved to be a honeycombed mass of lava, on which the water had dripped from the roof, and had frozen into what might, in the obscurity of the place, be thought to resemble a human figure. I think the sides of the cave show that it has been a crater of emission, for the surfaces are rounded, as if they had been acted on when in a plastic state. I was further confirmed in this opinion by observing a short distance below the cave a stream of lava, which had evidently not flowed from the Rembleta above. Some of the lava had a wrinkled or corrugated appearance, as if it had issued out in a half-fluid state, and had rapidly cooled as it trickled forwards by its own weight. It was extraordinary that the water could be retained in this basin of porous lava, but I think that the surface of the bottom had been glazed over in a similar manner as the sides, by the action of heat; besides, it was covered over with a bed of ice, on which the water rested; this was evident, as wherever I plunged my pole, it struck on ice. The ice-collectors I employed during my first attempt to ascend, assured me that they had often seen smoke or steam issue out of the cave, but I saw neither when I was there.

In three quarters of an hour after leaving the cave we arrived at a small plain of pumice, called the Rembleta, situated 11,721 feet above the sea; this plain appeared to have been the ancient crater of the Peak, from which most of the currents of lava had proceeded previous to the formation of the present cone, or *Pilon* (sugar-loaf), which rises nearly in the centre of this plain to an elevation of 479 feet. The foot of the cone was encircled by water entirely frozen over; it was no doubt derived from the snow which fell on the sides of the cone melting, which thus formed the narrow belt of water around it.

Although the actual elevation of the cone was small, yet I found the ascent the most difficult and fatiguing part of the journey. The surface is a light pumice and ash, with small pieces of porphyritic lava covered with an ochreous crust occasionally protruding through it. Some idea may be formed of the steepness of the cone when I mention that at the bottom the slope forms an angle of 35°, gradually increasing till, near the top, the angle is

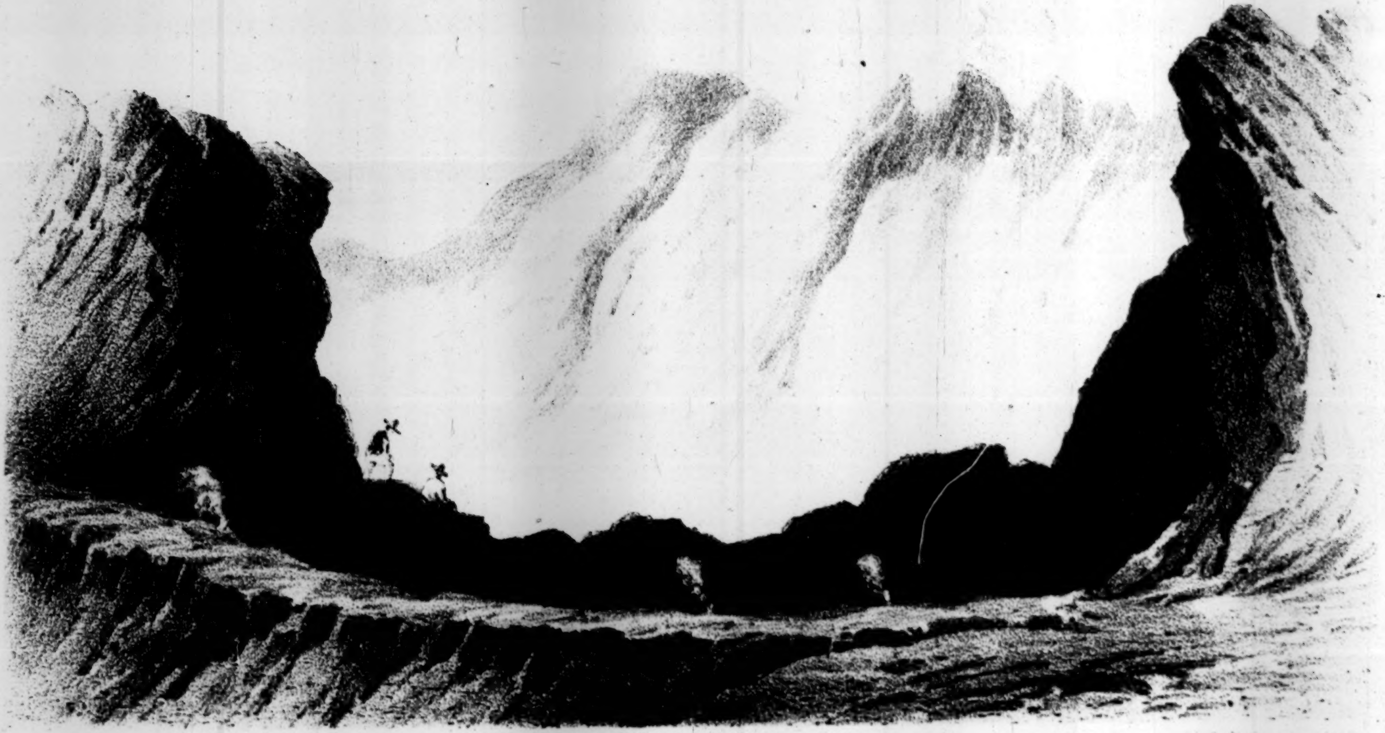
42°, which is nearly the greatest angle the body can ascend in walking without falling backward. The pumice and ashes gave way under my feet, and often caused me to slide back many yards before it was possible to stop myself, then I was arrested by some of the protruding pieces of porphyritic lava. In forty minutes after leaving the Rembleta, I seated myself on the highest pinnacle of the Peak, 12,200 feet above the level of the sea.

The Peak is a solfatara, that is (see Plate II.), a half-extinguished volcano The crater is much smaller and more shallow than I expected; round the summit runs a wall of porphyritic lava of an elliptical form, about 150 feet long, 100 broad, and 50 deep; the surface of the lava was coated with a soft white mass like dough, caused by the sulphurous acid vapours having acted upon the argil of the lava, and turned it into a sulphate of alumina. As I only paced the crater once for the purpose of measuring it, I am not certain that the dimensions I have given are perfectly correct. The bottom of the crater was unpleasantly hot, and the air so filled with vapours of sulphurous acid that I was continually sneezing, and the lungs felt sore and pained. The surface was covered with most beautiful trimetric crystals of sulphur, some of a yellowish white, others of a reddish and greenish colour. In some little caves, only a few feet deep, were some small apertures covered with splendid crystals of octahedral sulphur; on breaking some of them, I found in the interior a glistening white substance something like opal, only that it had a crystalline structure; on my return to England it was analyzed, and found to contain 91 per cent. of silex, and the rest water. The pasty substance on the surface of the lava, proved to be sulphate of alumina, muriate of ammonia, and a small quantity (0·5 per cent.) of sulphate of ammonia. Round the walls of the crater were several small apertures, like small pipes, about an inch in diameter, some of which were emitting steam, and others sulphurous acid vapours, which show that they must have proceeded from different sources, although some of the holes were only a few inches apart. The heat of the steam was considerable, for when I placed a thermometer graduated to 133° within their influence, the bulb burst.

The extreme dryness of the atmosphere and the radiation of the sun's rays were distressing; the lips cracked; the nails became brittle; the mahogany box, containing a Daniell's hygrometer, became unglued, and the case of a small pocket-sextant split across. The evaporation of the wet-bulb thermometer was so rapid that it was necessary to watch it closely, otherwise the muslin would be dry before the observation could be made.

The basaltic lava and the trachytes of the Peak were magnetic and had polarity, but I had no means of measuring it.

TENERIFFE. II.



The following were the observations made on the wall surrounding the crater, and a few feet below the highest point:—

	Sheltered Thermometer.	Black Bulb Thermometer.	Dew-point of Depression.	Boiling-point of Water.	Barometer.
Noon . .	54°·25	200°	62°	191°·125	19°·093

Although the atmosphere appeared perfectly clear, yet when I looked across the sun's rays from the shade of a rock, there was an evident dust-haze, probably brought over by the wind from the neighbouring desert of Africa.

The view from the top was most magnificent, the masses of cumuli, which had been resting at an elevation of 5,000 feet above the level of the sea, had entirely disappeared; with the exception of the islands of Forteventura and Lanzarote, the whole of the Canarian archipelago seemed to be close under my feet, the mountains of Grand Canary appeared as if on the island below, Palma 46 miles distant, and Gomera with Hierro were quite distinct.

I think it must be allowed that the Peak is a volcano of eruption, but there are strong evidences that it is nearly surrounded by a more ancient and enormous crater of elevation, termed the Cañadas, which form an atrium 23 miles in circumference.

The Cañadas are surrounded by cliffs of lava, varying from 540 feet to about 1,000 feet high; the plain of this crater is 4,383 feet lower than the mean elevation of the cone of the peak, which rises like a great mole-hill *nearly* in the centre of this atrium. From the cliffs of this atrium, various ridges of mountains spring out like the spokes of a wheel; some of them rise to an elevation of 8,950 feet, such as the Risco de Guajara, which is part of the elevated chain of mountains surrounding the Cañadas from the E. to W.S.W. These ridges of mountains, forming as it were buttresses, have radial valleys between them, running for some miles towards the sea.

As you pass over these currents and mountains of lava, the view is so bewildering, that it requires two or three visits before you can understand the system of these volcanic mountains, which can be done only by making a preliminary observation from a very elevated position, so as to take a bird's-eye view of the whole island, and then making more observations in detail on foot.

These various mountain ridges have all the appearance of having been at one time joined together, for when I examined their respective strata I found that they intercalated in the same manner; for instance, No 3 stratum in one ridge would be of the same type as No. 3 in an opposite one, though they were some miles apart.

Some idea may be formed of the great antiquity of the streams of lava that run towards the sea, by a careful examination of the large ravine which I have already mentioned as having been formed by a waterspout in November, 1826. In some parts of it, I counted no less than 75 various layers of lava and vegetable earth; some of the layers consisted of compact basalt, trachytic porphyry, and phonolite, between some of them were layers of vegetable earth three and four inches thick, with fine roots of plants turned into charcoal. Sir William Hamilton found that it took several centuries before the compact lavas of Vesuvius became covered with a thick layer of vegetable earth, here were various strata with layers of earth between them, showing that ages must have elapsed between some of the eruptions.

The question naturally occurs, Is there any probability of such eruptions occurring again? The crater of the Peak emits smoke and steam at intervals all the year round; after heavy rains I have often seen the crater throwing up dense columns of steam; as a proof that the fires are not far below, when I thrust my staff a few feet into crust of the crater, and withdrew it, I could not touch it, as it was quite hot.

In 1797, the town of Garrachica was entirely destroyed by an eruption from the volcano of Chajorra, which is about 2,000 feet lower than the top of the Peak, but whose crater is nearly a quarter of a mile in diameter. The Port of the unfortunate town was entirely filled up, and you now see churches, convents, and houses without roofs, and the walls protuding a few feet above the solid mass of basaltic lava. But the eruption of that year must have been a mere nothing in comparison with those of the distant times when the whole island was covered with liquid lava, forming the high cliffs which now guard its shores, and when masses of obsidian, many tons in weight, were launched into the air like huge volcanic bombs, some miles from the volcanic vent.

It may be interesting to know what is the best time of the year to ascend the Peak; from the experience I had from my frequent ascents to the Cumbre, at an elevation of upwards of 7,000 feet, I observed that the seasons above were much earlier than they were below, consequently the latter part of the spring is the best season to visit the Peak. While August and September have a mean temperature of nearly 73° at the Villa de Orotava, 1,141 feet above the sea, I found it was cold in the *shade* at an elevation of between 7,000 and 8,000 feet, with an extreme radiation and distressing dryness. During the latter part of the autumn the cold is most intense at night above, even much greater than during January and February, when the cold even on the summit of the Peak is far from excessive. When I ascended the Peak in October to an elevation of 10,700 feet, I found the cold greater than it was in February. I am aware that this is against the generally received opinion, but I give merely the result of actual experience and of numerous observations I made during my residence at Teneriffe.

From various observations I made at different elevations in Teneriffe, it is evident that the decrease of temperature is more rapid in the inferior strata of the atmosphere, and slower in the superior, but at a certain elevation (which possibly varies according to the latitude) the temperature in the summer season is almost stationary throughout the twenty-four hours; even in winter, during the middle of the day at the same elevation, and in Teneriffe the height of this stratum of air is from nine to eleven thousand feet.

If the decrease be uniform, the mean temperature of a certain elevation will be found by a thermometer placed between the lower and upper stations; but this is not the case, the error being much larger when taken in arithmetical, than in geometrical progression.

The temperature at Port Orotava was . . .	61°·5
That on the top of the Peak at the same time .	45°·875
Difference between the two stations . .	15°·625
If the temperature had decreased in arithmetical progression, that on the top ought to have been .	—15°·94
Or a difference between the two of . . .	77°·44
Instead of which I found it to be only . . .	15°·625

The following figures will show the difference of temperature per 1,000 feet: the difference of temperature between Port and Villa Orotava gave 5°·726 as the average difference per 1,000 feet of elevation; while between the Port and the Estancia de los Ingleses the average difference of temperature per 1,000 feet was only 2°·43. Taking the difference of temperature between the Villa Orotava and the Estancia de los Ingleses, it would be necessary to ascend 537·75 feet for an alteration of one degree of temperature, but between the Villa and the summit of the Peak, it would be necessary to ascend 1,317 feet for one degree of difference in temperature.

It is, however, impossible to know the exact temperature of any point by a single passing observation, as the thermometer may vary every moment according to the presence of the sun, the interposition of the clouds, a strong wind, or a calm; a level fog may occasion a refrigeration in that part of the atmosphere where the instrument is situated, which the rest of the air may not partake of; and any of these accidents may occur at the precise moment of observation. These can be all allowed for to a certain degree of correctness, but the immense difference between the supposed and observed decrement of heat, from the sea-coast to the top of the Peak, cannot be attributed to the effect of local causes, but must be ascribed to the incorrectness of the theory; and although it may never be submitted to accurate calculations, from the variety of disturbing causes, yet it may be brought to a near approach to truth.

Much has been done of late years by the intrepid and meritorious Mr. Glaisher in his ascents in a balloon, which have thrown much light on this subject; but it is much to be desired that some learned society would pay attention to this problem, and resolve it through direct and frequent observations; by establishing on the Peak a set of observations throughout the year: although it is covered with snow every year for the space of six or eight months, yet the cold is nothing to compare with that of the polar regions.

By means of a balloon, the experiment could occasionally be made, and with it the numerous local variations, now to be feared, would be entirely obviated.

II. THE CATTLE PLAGUE.

It is but a short history and description that can be placed on record here of the epizootic disease which has latterly decimated the herds of many of the Eastern Counties; for nothing has yet been discovered or devised capable of effecting the cure of this deadly disorder. The few instances in which cures have been alleged are given on doubtful authority, and the general experience hitherto has been that the percentage of recovery is as large in the cases of cattle receiving no special treatment whatever as in that of animals in the hands of the energetic medical man. We can thus do little more than relate the history and nature of the attack and of the measures, hitherto unavailing, which have been taken to meet it.

The disease was first noticed shortly after Midsummer in the north London cowhouses. The first animals that died were English cows which had been purchased at the Metropolitan Cattle Market. Three weeks before this purchase part of a cargo of Russian cattle landed at Hull—the first, it is said, that had been imported direct from Russia into this country—had been sold in the same market. Russia is the home of the rinderpest, and although the particular province from which these animals were imported has been declared entirely free from the disease in question, and notwithstanding the very long interval between their shipment at Revel and the outbreak on June 27th in the Islington cowhouse, and the fact that no mischief has been traced from the remainder of the cargo which left Hull for the Western Counties—it is declared and believed that to these Russian cattle we are to attribute the calamity which has befallen our stock owners, and especially the Edinburgh and London cowkeepers. These foreign cattle have introduced a new and specific poison into this country, which has spread with unexampled rapidity and virulence, destroying upwards of ninety per cent. of the animals in which it has become developed. This is the prevalent theory on the subject. There are, indeed, many who believe that our cattle plague is no new disease, but only the aggravation of an old-standing malady produced by the weakened condition of our live stock, owing to the hard summer and winter of 1864, and their subsequent indulgence in the luxuriant "keep" of the spring and summer of 1865—under the circumstances of the miserable crowding and confinement of town cowhouses. But they fail to account for the altogether unique virulence and destructiveness of the attack, and they assume without foundation that there were the same difficulty and difference in feeding the town-kept stock as were experienced in the country during the dry year 1864, which preceded this attack.

The London cowhouses are no doubt, many of them, disgracefully close; and the cattle are kept in an unnaturally excited state by food and warmth; but their condition has been improving of late years, and whereas formerly no supervision whatever was exercised, now that every cowkeeper must annually renew his licence, the justices are every year insisting on more stringent provisions for their regulation. In St. Pancras, when licences were first required, 600 cubic feet of space were insisted on for every cow. Since then the measure has been raised to 800, and latterly to 1,000 cubic feet per cow. In a cowhouse 16 feet square by 7 feet high—a cellar (open to the yard) beneath a dwelling-house—which we visited the other day, they used to keep ten cows! When first a licence was required the number was reduced to two, and now the licence is, very properly, altogether refused in this and every other case of cowhouses in or under dwelling-houses. We mention this in illustration of the improvement which had been witnessed in the condition of the London cows before the advent of this attack, which cannot, therefore, be attributed to the aggravation at this time of any long existing mischief in their management.

The Cattle Plague is, indeed, no new thing—not even in England—for the records of last century prove that a distemper equally sudden in its advent, and equally destructive during its continuance, attacked our herds in 1745–1757. To quote from the recently published report of the Royal Commission on this subject: "There is every reason to believe that the distemper which in 1715 made a brief inroad, but was promptly expelled, and which in 1745 renewed the attack and held its ground till 1757, was exactly the same as the present plague. Of this we have proof in the descriptions extant of the symptoms then observed, and of the morbid appearances after death. In a paper communicated to the

Royal Society in January, 1746, by Dr. Mortimer, he ascribes the origin of the murrain to two calves imported from Holland by a farmer living near Poplar, early in 1745. The spring and summer had been very wet, the autumn dry and cold, the early winter cold and damp. The disease communicated to the cows of this farmer spread through Essex, reached London, and was propagated in various directions from the metropolitan markets. The disease for some time advanced in a manner which appeared to justify the Government in treating its attacks as mere local outbreaks, and it was nearly a year after its first appearance that the country became sufficiently aroused to use national measures for the repression of it."

It has, moreover, been constantly more or less destructive in the Southern Provinces of Russia, where, indeed, they try to confine it by a rigid quarantine maintained between them and the neighbouring countries. Though not so destructive in its proper "home," it has proved extremely fatal wherever it has broken bounds and infected the previously untainted herds of Western Europe. Thus the report of the Commission already quoted informs us that "the Danish monarchy, in the four years from 1745 to 1749, lost 280,000 head, and Holland, in the three years begining with 1769, lost 395,000 head. These disasters attracted the attention of Governments and scientific men, and the long peace which began in 1816 permitted the adoption of those careful and systematic measures of precaution which, in the countries bordering on Russia, have been maintained ever since with various modifications, and, on the whole, with considerable success. It was ascertained that Europe usually received the infection through Russian steppe cattle sent into Poland and Hungary. Large herds of them are annually driven to different parts of Russia, to Poland, Galicia, and Hungary, and often carry with them the seeds of disease in their train. In 1862 the number attacked by the plague in the Austrian dominions was 296,000, of which 152,000 died. In 1863 it again invaded and overran not only Galicia, but the whole of the kingdom of Hungary and its dependencies, the Bukowina, Dalmatia, Carniola, Lower Austria, Moravia, and Styria." Fourteen per cent. of the cattle in these countries took the infection, and the average mortality, as stated in Schmidt's *Jahrbuch der Gesammten Medecin*, 1865 (p. 95), was as follows:—

	Per cent.		Per cent.
Hungary	65	Military Frontier	83
East Galicia	77	Moravia	88
Croatia and Slavonia	81·6	Lower Austria	92

That the disease which has thus been so constantly the terror of Eastern stockowners is the same which is now so destructive here, is proved by its symptoms. These are thus described by Dr. Smart, of Edinburgh:—

"1. *Period of Incubation.*—This is the latent period of the disease, beginning with the reception of the poison by the animal, and terminating when the symptoms of its development in the system become apparent. The duration of this period has been variously stated, but all my observations lead me to conclude that it terminates on the seventh day, by the outward manifestation of distinctly recognizable indications. These are—

"2. *The Earliest Recognizable Symptoms.*—They are enumerated as nearly as possible in the order in which they appear. 1. Loss of appetite. This shows itself (1) by an aversion to all sorts of 'green' food. The next day or the following there is (2) indifference to food of any kind. The animal still eats, but languidly, does not lick out the pail, or leaves a portion of the meal, and soon thereafter refuses food altogether. She now ceases to chew the cud, and from this time there is commencing constipation, with progressive diminution of the milk. She looks depressed, stands much in the same posture, with drooping head and reclining ears. The ears, horns, and other extremities are now sensibly under their natural temperature. The breathing is yet but slightly accelerated, and the expiration (or outbreath) perceptibly prolonged, and the pulse rises a few beats in frequency. It is at this period the orifice of the vagina reddens, and the colour deepens as the disease advances. This appearance of the vulva is the most characteristic and trustworthy mark of the disease at this stage. A faint red or purple line about the same time appears on the undergum along the roots of the teeth. All these symptoms concur within a day or two of the incubation period. The diseased condition of the internal organs after death clearly points to this and the preceding period of the disease as the proper time for successful treatment, before destructive changes have too far advanced.

"3. *More advanced Symptoms.*—The breathing is now more accelerated, oppressed, sighing, and laborious. The number of respirations varies generally from 36 to 70 per minute. The pulse is more rapid (from 60 to 110 pulsations per minute) and weaker. There is continued loss of appetite, constipation, and thirst. The superficial membrane of the mouth, especially of the inner side of the upper lip, roughens, and a viscid discharge appears in the vagina. A similar appearance is seen on the membrane of the vagina where it joins the skin. The milk is scanty, and entirely changed to cream, or there is none at all. All the other symptoms are more decidedly pronounced. The likelihood of recovery is greatly diminished by delaying treatment to this period.

"4. *Most advanced Symptoms.*—They are those which shortly precede death, and are unattended by any very marked outward signs of pain. The breathing is now slow, very laborious, and moaning or grunting. Pulse slow and small. Where purgatives have not been given there is great distention of the abdomen, and obstinate constipation. The fluid and sometimes sanguineous discharges from the bowels, which occur in some cases, are the results generally of the too frequent use of irritant drugs. The superficial membrane of the mouth peels off from the gums and lips, leaving the surface raw; and frequently, but not invariably, there is a viscid discharge from the eyes, nostrils, and vagina. The animal now dies without a struggle, apparently from simple exhaustion.

"The 'staring hide' and 'arched back,' so frequently mentioned as distinctive features of this disease, while characteristic of the advanced forms of pleuro-pneumonia, are not at all marks of the rinderpest. There is no cough or lung symptom in the pure and uncomplicated examples of the disease."

The loss of appetite is a first symptom of many other diseases besides rinderpest; nevertheless such is the dread of the cattle plague, that in the London cowhouses, where it is the invariable custom to fatten cows towards the close of their milking, and to keep them throughout the period in tolerable condition for the butcher, it has latterly been almost universally the practice to slaughter a cow as soon as she goes off her feed. Her carcass will pass inspection at market, whether the earliest appearances of the plague (patches of inflammation on the mucous membrane of the fourth stomach, and longitudinal and transverse streaks on the membrane lining the small intestines) have been developed or not. And though the idea of such meat entering our markets for consumption in any quantity is not very agreeable, yet it is declared that while the disease is thus still in or only just passing out of the incubative stage, the flesh of the animal is perfectly wholesome. The owner thus prefers the loss in part which he sustains by the sale of a milk cow to the butcher, to the total loss which, if she prove to have the plague, he is certain to incur, for the treatment of the disease has hitherto been ineffectual. Some such remedy as Dr. Smart recommends,* common enough, indeed, as a drench well known to herdsmen, of which the main ingredients are sulphur

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* Dr. Smart's dose for a cow, in the earlier and later stages respectively of the malady, is as follows:—"There are only three kinds of drugs which I found it requisite to employ. 1. Laxative, with diuretic action. This is principally used in the early, but often required at other periods, in the progress of the disease. It is composed of—

Laxative.

Nitrate of potash }
Powdered ginger } of each 1 oz.
Powder of sublimed sulphur, 2 oz.
Treacle, 1 lb.
Water to make a quart, and well mixed.

This quantity is given night and morning, or, if requisite, oftener, until scouring is produced. Afterwards an occasional bottle will maintain their free, without excessive, action.

As the vital powers sink rapidly, there should be as little delay as possible in and nitre (laxative and diuretic), combined with warm clothing enough to make the animal perspire profusely, so that skin, stomach, and kidneys are all excited to unusual action, with the view of getting the poison out of the system, is advisable in the first stage of the attack. And the earlier the symptoms can be perceived and recognized, the better the small chance of success in the treatment of the case.

In spite, however, of treatment, a herdsman finds a cow or two, that may have been off their feed for a day or two without exciting much observation, suddenly displaying one after another the train of symptoms which we have quoted from Dr. Smart; and if he does not at once get rid of his herd, in a very few days or weeks the plague runs through the whole of them, and not five per cent. of them survive. Whole herds have thus been lost. Lord Granville's herd, near Hendon, was one of the earliest. A neighbour had lost some cows by the disease, and the contagion in some unexplained manner reached his lordship's byres, and nearly all the cows died under it. Calves bought in the Metropolitan Market and sent to Norfolk, Essex, and Sussex, carried the contagion with them, and forthwith whole herds disappeared. A London cowkeeper finding something wrong with his herd in town sends them all over to his farm near Guildford, and forthwith the whole district there is infected, and one and another lose their all.

The disease is unquestionably more virulently contagious than any other known, though there is still some doubt whether it be capable of transmission to any other kind of animal. Mr. Harvey's flock of sheep at Crown Point, near Norwich, was indeed struck with an extremely fatal disease, very much resembling the cattle plague in the symptoms during life, and in the appearances after death; and this happened very soon after the herd on the same estate had suffered from the rinderpest; but, on the other hand, the experiments

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administering stimulants. I have found the following mixture, possessing stimulant, diuretic, and diaphoretic properties, very efficacious :—

Stimulant.

Carbonate of ammonia, ¾ of an oz.
$\left.\begin{array}{l}\text{Sweet spirit of nitre}\\ \text{Spirit of mindereris}\end{array}\right\}$ of each 1½ oz.
Cold water, 9 oz. Mix.

This dose, from the commencement of treatment, is administered thrice a day during the entire course of the disease. When prostration is great it is sometimes needful to conjoin it with the laxative given along with all other medicines. In such cases the doses are smaller.

When convalescence is fully established, a simple tonic hastens recovery. I find none so good and safe as cinchona bark. The best quality only should be used, and given in doses of 1½ oz. of the powder.

This tonic in the early period of convalescence is combined with the stimulant, and at a later period with a quart of good sweet ale given once daily. It is best administered at night. With the exception of an occasional dose of laudanum (two tablespoonfuls to any medicine the animal is getting, or in the food) to obviate straining and control excessive diarrhœa, no other drugs are used."

at Edinburgh, in which healthy sheep had been kept for weeks in the sanatorium where diseased cattle were under treatment, seemed to show that the disease was not communicable.* In an address on this subject to the Wayland (Norfolk) Agricultural Society, Mr. Woods, of Merton, an undoubted authority on sheep management, discussed the whole history of the Crown Point flock during the past summer, and gave it for his opinion that the disease which had been so fatal among them was not the rinderpest; and we learn from him that on large Russian estates, where flocks and herds are pastured together, the former are not liable to the disease which destroys the latter.

There is no doubt, however, that it is wonderfully liable to spread among cattle when once a case has happened. The reports to the Privy Council by the veterinary inspectors recorded that from 1,000 to 1,800 cases a week occurred during the three weeks ending October 28th, and there cannot be a doubt that in a multitude of instances the veterinary inspection is altogether evaded. The cases reported were chiefly in the metropolitan district and in the southern and eastern counties and in Scotland; and of the 17,673 cases altogether up to the end of October only 848 recovered.

The measures taken by Government within the powers conferred upon them by a recent Act of Parliament, have been confined to the appointment of veterinary inspectors, with power to enter premises and direct the slaughter and the burial of infected animals —the infliction of penalties upon anyone selling from a diseased herd without the inspector's permit, and in a few cases an enforced imprisonment of the livestock of a particular district or province within the boundaries of that district. That this has proved insufficient is plain from the progress of the disorder; and her Majesty's Commissioners, to whom an inquiry into the whole subject was remitted, have at length reported by a majority of their number in favour of an enforced entire cessation of movement in cattle (except within their several farms) throughout the kingdom for a sufficient period; leaving the markets to be wholly supplied by dead meat. A very influential minority of the Commissioners, however, do not believe that this is possible, and therefore unite with their colleagues only in the alternative measures which they advise in the event of the severer recommendation being refused. The measures thus indicated are included in the following particulars:—

"*a.* For a definite period no lean or store stock should be permitted to be sold at any fair or market, or in any other manner whatever.

"*b.* Cattle might be moved for immediate slaughter to a market or to a slaughterhouse licensed for use, but only under a licence for transit. With this exception, and except cattle driven from one part of the same farm to another, the transit of cattle should be absolutely prohibited.

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* It has been since announced, that sheep inoculated from diseased cattle have died with all the symptoms of rinderpest.

"*c*. Precautions should be taken that every animal sold for butcher's meat be slaughtered within a short and fixed period. Cattle sold at a fair or market should not be allowed to leave the precincts of the place alive.

"*d*. It would be desirable to draw some more distinct line between infected and uninfected districts than is at present traced by the orders in Council. The egress of live cattle from a proclaimed district should be strictly prohibited, but cattle slaughtered within it and certified by the district inspector to be fit for food might be sent out of it."

These, then, are the measures which the Royal Commissioners recommend, and which Government will, in all probability, adopt, in order to confine the disease to the particular herds in which it exists, for long enough to ensure the destruction of the poisonous contagion.

It is to be hoped that when that event shall happily have arrived, a much severer inspection of imported cattle will be instituted at the ports of departure and arrival than has hitherto been possible. We conclude with the review of the subject which the report of the Commissioners contains:—

"The cattle plague is, in the language of medicine, a specific disease, belonging to the class of contagious fevers. The contagious matter is subtle, volatile, prolific in an unexampled degree. It is conveyed in a most virulent form in the excretions from the diseased animal. Any particle of those excretions may serve as a vehicle for it. We know not the limit of time within which it disengages itself from them, nor to what distance it may not be diffused. It may travel, we know, in the hide, horns, hoofs, and intestines of the dead animal; the offal, therefore, is highly dangerous. It lurks undeveloped in the system for a period about which some difference of opinion exists, which certainly is not less than five days, usually seven or eight, but appears to be more prolonged in some cases. Towards the end of this period of incubation, but at what precise point we do not know, it becomes capable of diffusing itself by contagion. A diseased animal may, therefore, be infectious before it shows any signs of disease, or, at all events, before the malady betrays itself to any but a very close and very skilful observer. The proportion of cases in which it is fatal is extraordinarily large. No specific has been discovered which neutralizes or expels the poison; judicious treatment may enable nature to resist till the virus has spent itself; injudicious treatment may have a contrary effect; but that is all. The practical conclusion, therefore, at which foreign physicians and foreign Governments have arrived,—the conclusion that it is better always to kill a diseased animal, or a few diseased animals, where by so doing you can kill an isolated germ of disease instead of suffering that germ to linger and fructify while you are attempting a cure, for the precarious prospect of an insignificant saving,—is justified by reason; it is also directly justified by experience, which shows that while the plague, propagated from a single germ, speedily becomes unmanageable, spreads from herd to herd, from province to province, and from country to country, multiplies in a continually increasing ratio, and exhausts itself only after ruinous havoc and a long course of time, it may be effectually eradicated by prompt and unsparing measures. The experience of Prussia is especially valuable in this respect. The plague has often appeared, says Professor Gerlach, in the provinces bordering on the Russian empire, in East Prussia, Posen, and Silesia, but it has never since 1815 penetrated eastwards, even so far as Brandenburg. Lastly, we must add, it has not been found to give way before cold weather or rain. The reverse seems to be the case. It is worse, Professor Gerlach informs us, 'in cold and wet weather, and better in warm and dry weather.' 'It spreads,' says Mr. Ernes, 'as fast in a cold as in a hot season.' The murrain of 1745 broke out here in early spring, the temperature of the preceding year having been low; and it is stated to have raged most violently during the winters, and to have diminished in intensity with the advance of summer.

" These conclusions, which are all that for our present purpose it is necessary to state, are far, of course, from exhausting all that is known upon the subject. Beyond what is known, however, there is a large field of inquiry which may be usefully explored. To observe carefully the premonitory and progressive symptoms of the disease under various conditions—to determine precisely the period of incubation, the effect of remedial and of preventive agencies (including under the latter head disinfectants, therapeutical measures, and inoculation)—to ascertain within what range and under what modifications the poison may be communicated from a diseased cow to other animals of the same or different species—these are branches of investigation practically important, but which will take time. With a view to the thorough examination of them, we have obtained the assistance of men eminent in various departments of science, and we hope to be able to report on them hereafter. But we have now to deal with more pressing questions. Are the measures hitherto adopted to stifle the plague at home and stop its entrance from abroad effectual for the purpose? If not, what other measures are likely to be effectual? To these questions, having early satisfied ourselves of the general character of the disease, we at once directed our attention; and the evidence which we have received has been chiefly taken with a view to them."

III. ON THE RECURRENCE OF SPECIES IN GEOLOGICAL FORMATIONS.

By A. C. Ramsay, F.R.S.

The paper by Mr. Jenkins in the last number of this Journal, "On Strata Identified by Organic Remains" (an article which I have read with interest, and the value of which I appreciate), induces me to publish this brief communication with a view to point out that it seems to me that some of Mr. Jenkins' arguments may lead to a total misunderstanding of the reasoning employed in my anniversary addresses to the Geological Society in 1863 and 1864. My chief object in these addresses was to show the connection between unconformity and the partial or complete change of marine faunas during times unrepresented by strata, and in discussing the question whether (as had been asserted) a Silurian, a Devonian, and a Carboniferous fauna might all coexist in different areas, I stated if it were so, "that in the piles of formations" of Europe and America, "the chances are overwhelmingly strong, that in each or in some one area there might be a *recurrent fauna*, which is not the case."

Mr. Jenkins quotes the foregoing passage, and a little lower in the page he points out that I refute myself in my own address, because in discussing the Lower Oolites, I state, that "the majority of the forms that passed upwards from the Inferior Oolite limestone seem to have fled the muddy bottom of the Fuller's-earth sea, and to have returned to the same area, when the later period of the Great Oolite began." "Here," says Mr. Jenkins, "Professor Ramsay acknowledges a recurrent fauna."

Certainly there is a recurrence of forms, *but only to a very limited extent*. The *fauna* of a province or of a formation means the collective species of the province or formation, and not a small percentage of them. My arguments in part are based on facts of that kind, *viz.* that in certain cases there is recurrence of species not in mass but in small numbers. In this case, out of about 700 Great Oolite species, only about eighteen or twenty per cent. are found in the inferior Oolites beneath, whereas, from want of showing how I considered the question as a whole, Mr. Jenkins' readers might imagine that the fauna of the Great Oolite, *is* the fauna of the Inferior Oolite *recurrent*. This is very far from being the case, and in my address I do not hint at anything that would lead to an inference so erroneous.

But supposing that there were a recurrence of Inferior Oolite complete species in the Great Oolite, or on a great scale, it may then occur to those who remember my addresses that they are expected to draw the inference, that the Inferior Oolite, Fuller's-earth, and Great Oolite are formations comparable in importance, physically and in their faunas, to the Silurian, Devonian, and Carboniferous formations, the faunas of which were supposed by Professor Huxley to have been possibly contemporaneous in different parts of the world. It might be allowable to compare the Oolitic Subdivisions named above, with any three minor subdivisions, for example, in Upper Silurian strata, but few Geologists will require to be reminded that such minor subdivisions are not comparable to the three great series, Silurian, Devonian, and Carboniferous, each of which contains several groups of formations, some of which groups are comparable to the whole Oolite series of Britain taken together.

IV. SYNTHETICAL CHEMISTRY.

1 *On the Synthesis of Organic Bodies.* Lecture at the Royal Institution of Great Britain, February 12, 1864. By J. A. Wanklyn.

2. *On Recent Chemical Researches in the Royal Institution.* Lecture at the same Institution, June 3, 1864. By Edward Frankland, F.R.S.

3. *On Researches in Organic Chemistry in the Royal Institution.* Lecture at the same Institution, June 9, 1865. Same Author.

4. *On Animal Chemistry.* A Course of Six Lectures at the College of Physicians. By William Odling, M.B., F.R.S. Especially Lecture 5, reported in the 'Clinical News' of September 8 and September 15, 1865.

THERE are hundreds of restless, prying men, who would to-day, as did the fabled Titan, steal down the fire from heaven and vivify a human form, or failing that, would be content to animate the merest speck of organized material.

This is the aim to which the efforts of mankind, at least of our most earnest investigators, are half-consciously tending at the present time; but whether or not it will ever come within the scope of man's ability so to mould the elements and imitate the work of nature, as to fit them for the reception of that mysterious force or combination of forces termed "life," it is impossible to say; at least, it is not the will of Him who is the author of all force, that man should, at this stage of his existence, stand forth as a creator even of the humblest living form. To go a step beyond this, and affirm that there is this or that in nature which he cannot do, or should not attempt; to dogmatize upon the things of which he ought to remain ignorant, or whose investigation should be avoided as an impious attempt to pry into and interfere with the Creator's works, is to exhibit the greatest want of faith, not alone in man's powers and destiny, but in the might and goodwill of his Maker: it means, in fact, to abdicate man's noblest powers, neglect his highest faculties, return to the darker stages of his existence,—for where there is no progress there must be retrogression,—and to make him the image of God in name alone and not in nature. The story of Prometheus is, in common with many others of a similar character, merely a childlike fancy of man in the earliest stage of his history, which is every day approaching realization in another form, just as the efforts of the old philosophers and alchemists were the result of dreams which have become in our day living realities. The creative powers of man have to be educated, just as all his other faculties; and this, the highest portion of his nature, has been more gradually yet more systematically developed than any other. The principle upon which his mind has been trained may be exhibited by a very simple illustration.

There are few of our readers who have not seen those interesting little puzzles shaped like a double cross. When the curiously-formed pieces of wood which constitute this cross are placed in our hands for the first time and we are invited to construct the object, we often spend hours in the vain attempt to do so; but let the pieces once be put together by hands that are in the secret, and the cross presented to us entire, and give us then the opportunity of carefully and observantly removing piece by piece until the whole is completely dissected, and we shall find but little difficulty in reconstructing what we had before laboured in vain to build up.

The simile, it must be admitted, is imperfect; but true it is that before we can synthetize we must understand *well* how to analyze; and it is not improbable that when all that the searching mind of man can accomplish in the unravelling of material complications has been effected, and when he sees with tolerable intelligence all the processes of nature in the dissolution of her living forms, and is able with the aided or unaided eye to follow her formative processes; when he has been able to accomplish all these things, then it is not improbable that he may become skilled enough to construct the organized tissue in which vital force (let physicists call it what they will) finds a medium of action, just as he is now capable of preparing those mechanical contrivances which are rendered self-moving by the obedient forces of the physical world. One important step has been already made in this direction, for if he cannot yet form that plastic material, that protoplasm, in which life is first seen to dawn, at least he has robbed nature of her exclusive privilege to create substances which it has hitherto needed vital influences to produce. If he cannot usurp her powers so far as to make organized tissues, at least he has succeeded in constructing synthetically some of the proximate principles of which they are constituted, and it is to the present state of his knowledge and attainments in this branch of chemical science that we now propose to direct attention.

When we compared the analytical and synthetical experience of our investigators with that of an ordinary person taking to pieces and reconstructing a well-known puzzle, we said that the simile is imperfect, for the power in man to build up organic substances is not the immediate sequel to his analytical experience. "The pulling to pieces of these substances," says Wanklyn, "is a matter of very little difficulty: more than fifty years ago chemists could do that—but how to put the pieces together again is a much more difficult task. Sugar consists of 72 parts by weight of carbon, 11 parts of hydrogen, and 88 parts of oxygen. We may bring together carbon, hydrogen, and oxygen in these proportions, and shake them up together, or heat them, or cool them, and yet we shall never get them to combine so as to form sugar. Alcohol consists of 24 parts of carbon, 6 parts of hydrogen, and 16 parts of oxygen, but no alcohol ever results from making such a mixture. Neither sugar nor alcohol can exist at the temperature to which it is requisite to raise our mixture of carbon, hydrogen, and oxygen, in order to get chemical action to set in. At ordinary temperatures the organic elements will not enter into combination, whilst at high temperatures they combine it is true, but yield comparatively very few compounds."

That the chemist has, however, been able, by a series of synthetical operations, to build up alcohol—a product which previously nature alone was able to furnish—will be seen presently; and not alone has he succeeded in fabricating this organic material, but many others, both in the plant and animal realm, the chief of these being oxalic acid, resembling that extracted from the common wood sorrel; acetic ether, the flavouring substance of certain wines (consequently the product of the grape-plant); amylic and butyric ether, the essences respectively of the pear and pineapple, in the vegetable kingdom; and in the animal kingdom, the well-known substance glycerine, the sweet principle of animal fats and oils; lactic acid, the acid of sour milk; formic acid, the product of vital action in ants; and leucine, a fine white powdery substance resulting from the treatment of certain organic tissues with dilute sulphuric acid. The last is ordinarily found in the spleen, pancreas, liver, bile, kidneys, and salivary glands. All these and many allied substances have of late been synthetically prepared from inorganic elements; but the first organic material thus artificially constructed was *Urea*, an excretory product of the mammalia, and this was effected by a German chemist (Wöhler), in the year 1828, in the following manner:—"Cyanide of potassium—a body which can exist at a red heat, and which can moreover be formed directly from its constituents, carbon, nitrogen, and potassium—was oxydized by means of peroxide of manganese at a low red heat, and so cyanate of potash was obtained. The cyanate of potash was next converted into cyanate of ammonia by double decomposition with sulphate of ammonia. Thus cyanate of ammonia was produced from its elements by a process which, although indirect, still did not involve the action of either a plant or an animal. Cyanate of ammonia becomes *urea* when its solution in water is simply evaporated to dryness."

This simple account, by Wanklyn, of the first step in synthetical chemistry, is followed by a recital of the discoveries of succeeding chemists. Three years afterwards, Pelouze, a French investigator, produced formic acid; and we shall now give his process, as described by Wanklyn, with a hearty tribute of praise to both these chemists for the services they have rendered to science.

If we pass nitrogen gas over a mixture of carbon and hydrate of potash heated to whiteness, cyanide of potassium is the result, and when that substance is boiled with a solution of hydrate of potash, formate of potash is produced. If we distil formate of potash with sulphuric acid, we then obtain *formic acid*, the acid of ants. This is the simple process by which Pelouze succeeded in building up formic acid, but the synthesis need not terminate here; if we slightly retrace our steps, we find that from one and the same substance, formate of potash, not only an animal acid is obtainable, but a vegetable acid may also be synthetized. For if formate of potash be heated with hydrate of potash the result is oxalate of potash, and from this we can obtain *Oxalic acid*, similar to that extracted from common sorrel, *Oxalis acetosella*.

Returning now to the history of this infant science, we find that in 1845, Kolbe, another German chemist, constructed *Acetic acid* from its elements, and the author of the discovery tells us that "if we could transform acetic acid into alcohol, and out of the latter could obtain sugar and starch, then we should be enabled to build up these common vegetable principles by the so-called artificial method from their most ultimate elements." A portion at least of the German savant's anticipations has been realized; for we *can* build up alcohol from its inorganic elements; indeed the discovery was in part made by our own chemists, Faraday and Hennell in 1820, before the synthesis of urea was effected by Wöhler, but their experiments were only recently confirmed and synthetically completed by the more extended researches of Berthelot. The following must serve as a description of the mode of producing alcohol by synthesis, and we trust that it will be found generally intelligible. The first step in the synthesis is the production of acetylene. When the carbon points used for the electric light are ignited by an electric current in an atmosphere of hydrogen, acetylene is produced. (The hydrogen may be obtained from water, and the carbon from marble, both inorganic sources.) With acetylene (a gas) we obtain acetylide of copper by passing the former through the subchloride of copper, and by bringing acetylide of copper into contact with nascent hydrogen we form *Olefiant gas.* This may be termed the second step in the synthesis, olefiant gas being itself an organic product. The third and final synthesis is that performed by Faraday and Hennell, and it consists, first, in the agitation of olefiant gas with sulphuric acid, the result of which is sulpho-vinic acid. This is then mixed with water and distilled, when alcohol comes over, mixed, however, with water; from which it is freed by placing it in contact with quick-lime for a day or two and then distilling it again at the temperature of boiling water. *Pure vinic alcohol* now passes over, all the water remaining behind in combination with the lime. Having thus obtained vinic alcohol from inorganic materials only, we can employ it to form, by synthesis, a vast number of other organic products. Thus by Mendius's reaction (so called after its discoverer), which consists in the addition of hydrogen to the compound of cyanogen with the basis of vinic alcohol, we obtain propylic, butylic, and amylic alcohol. If we select one of these, propylic alcohol, and oxydize it, we convert it into propionic acid; and when propionic acid is subjected to the consecutive action of chlorine and hydrate of potash, the product is the well-known substance *Lactic acid*, the acid of sour milk. Again, vinic alcohol submitted to oxydation produces *Acetic acid*, from which we may construct, by synthesis, the essences of certain fruits, often vended by druggists to persons who have not the remotest suspicion of the true character of their purchases. Having described the syntheses of vinic alcohol and acetic acid, it is only necessary to state that when these two are distilled together, they produce *Acetic ether*, the bouquet of certain wines; and again, if vinic alcohol be thrice treated according to Mendius's process we obtain amylic alcohol, and that substance distilled with acetic acid gives the "*Essence of pears.*" And further, if acetic ether (the bouquet of wines) be treated, first with sodium, and then with iodide of ethyl, it gives butyric ether, the "*Essence of pine-apples.*" How numerous are the dissimilar substances produced from almost the same simple elements; and how completely does the study of synthetical chemistry confirm all other evidences of the unity of the operations of nature!

Passing over the synthesis of *Glycerine* from propylic alcohol (one of the products of vinic alcohol already referred to), we may mention that the combination of glycerine with the so-called "fatty acids," acetic, propionic, butyric, &c., all of which are synthetized by the oxydation of propylic and other alcohols as already stated, that the combination, we say, of glycerine with the fatty acids yields *several oils and fats similar to animal and vegetable oils;* and now we will conclude this hasty glance at the synthesis of organic compounds by a brief reference to the substance *Leucine*, which has been found to characterize the tissues of the spleen, liver, kidneys, &c., of the mammalia.

We have already described the synthesis of vinic alcohol, and stated that Mendius converted that liquid into amylic alcohol, by treatment with cyanogen compounds and hydrogen. Now, if this amylic alcohol be carefully oxydized, it is converted into "Valerianic aldehyde." Another substance which may be prepared by synthetical chemistry from nitrogen, carbon, and potash, is cyanide of potassium; from this the well-known prussiate of potash is obtainable, and from prussiate of potash we easily procure the equally well-known substance, prussic acid.

When valerianic aldehyde, obtained synthetically, is treated with prussic acid (similarly prepared), the desired synthetized product, *Leucine*, is a result of the combination.

Thus, then, we see that organic substances yielded by plants, and others by animals, may be easily produced by synthetical chemistry from other compounds, of a kind more nearly approaching the products of inorganic nature, whilst these may themselves be synthetized from what we term the chemical elements.

But *cui bono?* will be the natural and inevitable question, to which it is always necessary now-a-days to give a prompt and satisfactory reply, otherwise synthetical chemistry will rank but one grade above alchemy and astrology. There need, however, be no difficulty in pointing out the immense benefits to mankind, which are sure to accrue from the practical study of this infant science. The advantages of being served with a compound of amylic alcohol and acetic acid when one goes into a shop to purchase essence of pears, or with a similarly prepared compound as a substitute for essence of pine-apples, may not be quite obvious to every one, and much as we may admire the ability of the chemist who manages to cheat our very senses, we cannot help avowing a preference for the genuine products of nature.

There are, however, organic substances used in the arts, for which the demand is becoming so large, that unless the manufacturing chemist steps in to the rescue, they will be placed beyond the reach of ordinary consumers; and as every day witnesses an increase in the number of such substances that may be synthetically prepared, it is impossible even to discuss the probable boundary within which the unpretending researches of the laboratory are to be confined. At present the application of the science in the direction here pointed out appears unlimited. But there is a question at issue of far greater moment than the tickling of the human palate, or even the supplying of some of man's more indispensable domestic requirements; the health, the very life of man, is affected by these new discoveries in science.

The practice of hygiene may in one sense be compared to that of agriculture. The old fashioned farmer used formerly to apply special composts and manures to the soil for promoting the growth of particular plants, though there was a period when he applied the same manure in every case. Even after his experience had taught him that the growth of particular plants is fostered by special manures, he was still ignorant of the why and the wherefore. All he knew was that it *was* so. Presently the researches of the agricultural chemist revealed the constituents of the various plants, and enabled the farmer intelligently to apply the respective materials of which the soil had been exhausted. The analyst performed the diagnosis; the farmer, under his advice, effected the cure, and precisely so it is in the practice of medicine.

Inquire of a medical man, even to-day, what means he is employing to relieve some particular disease or to sustain a sinking frame, and too often the reply is, avowedly or by inference, that he is essaying first one and then another medicinal agent to effect a desired end; groping about, as it were, by a dim and uncertain light. Now the analyst and synthetist come to his aid, and together they stand in the same relation to him as the agricultural chemist to the practical farmer. Between them they must ascertain the organic constituents of which the system stands in need, and if nature cannot be pursuaded to supply the deficit, it will be the joint duty of the synthetical chemist and physician to do her work.

It is indeed difficult in this early stage of the science to define precisely under what circumstances synthetical chemistry will step in to the aid of the baffled medical practitioner, but that it has already done so in some instances, no one will venture to deny, nor will any one, on the other hand, pretend here, as in the case of its application to the arts, to mark the boundary within which the operations of the laboratory will in future be confined.

So much for the consideration of two of the leading utilitarian aspects of synthetical chemistry, but, as we hinted at the commencement of this essay, the highest aim of this as of every other effort of the human intellect, is to increase his knowledge of the laws of nature, to extend his power of controlling and utilizing her operations, and to obtain a better insight, so far as his senses will allow him, into the works of the Creator. Perhaps, with reverence be it spoken, to prepare himself, by the fabrication of organic and it may be even of organized matter, to become one day, here or hereafter, a creator himself under the divine government.

The increase of social comforts and enjoyments, then, his bodily health, and his mental development are the legitimate motives that should actuate man in prosecuting the study of synthetical chemistry.

Synopsis of Chemical Reactions referred to in the foregoing Article.

1. Synthesis of acetylene ($C_2 H_2$) from hydrogen and carbon in the electric arc (Berthelot).

2. By passing acetylene gas through subchloride of copper, acetylide of copper is produced.

3. Acetylide of copper in contact with nascent hydrogen, gives olefiant gas ($C_2 H_4$).

4. Agitated with sulphuric acid, olefiant gas produces sulphovinic acid ($SO_4 C_2 H_6$), from which common or vinic alcohol ($C_2 H_6 O$) is readily obtained.

5. From vinic alcohol the following alcohols can be produced by Mendius's reaction:

Propylic Alcohol . . .	$C_3 H_8 O$
Butylic Alcohol . . .	$C_4 H_{10} O$
Amylic Alcohol . . .	$C_5 H_{12} O$

6. By the oxydation of these alcohols, they yield respectively the following organic acids:

Vinic Alcohol	yields	Acetic Acid.
Propylic Alcohol	,,	Propionic Acid.
Butylic Alcohol	,,	Butyric Acid.
Amylic Alcohol	,,	Valerianic Acid.

7. From propionic acid, the acid of sour milk—lactic acid ($C_3 H_6 O_3$) is obtained by the consecutive action of chlorine and hydrate of potash.

8. From the alcohols, the zinc compounds of the alcohol radicals are obtained; *viz.* from

Methylic Alcohol . .	Zinc Methyl.
Vinic Alcohol . . .	Zinc Ethyl.
Amylic Alcohol . .	Zinc Amyl.

9. By the action of the zinc compounds of the alcohol radicals upon oxalic ether, the following acids of the Lactic family are produced, of increasing complexity:

Dimethoxalic Acid	$C_4 H_8 O_3$
Ethomethoxalic Acid	$C_5 H_{10} O_3$
Diethoxalic Acid	$C_6 H_2 O_3$
Amylohydroxalic Acid	$C_7 H_{14} O_3$
Ethyl-Amylhydroxalic Acid . . .	$C_9 H_{18} O_3$
Diamyloxalic Acid	$C_{12} H_{24} O_3$

10. When nitrogen gas is passed over a mixture of carbon and hydrate of potash heated to whiteness, cyanide of potassium (KC N) is produced.

11. When cyanide of potassium is boiled with solution of hydrate of potash, formate of potash ($CHKO_2$) is produced. From this, formic acid ($CH_2 O_2$), the acid of ants is obtained by distillation with sulphuric acid.

12. When formate of potash is heated with hydrate of potash, it is converted into oxalate of potash ($C_2 K_2 O_4$), whence oxalic acid ($C_2 H_2 O_4$), same as from oxalis acetosella.

13. Oxalic acid heated with alcohol gives oxalic ether ($C_6 H_{10} O_4$) used in No. 9.

14. By the action of anhydrous phosphoric acid upon the acids No. 9, the latter are converted into acids of the Acrylic series, thus:

Dimethoxalic Acid gives Methacrylic Acid	$C_4 H_6 O_2$
Ethomethoxalic Acid gives Methylcrotonic Acid	$C_5 H_8 O_2$
Diethoxalic Acid gives Ethylcrotonic Acid	$C_6 H_{10} O_2$

15. Distilled with alcohol, acetic acid gives acetic ether ($C_4 H_8 O_2$), and with amylic alcohol, amylic acetate ($C_7 H_{14} O_2$). The first constitutes the bouquet of several wines, the second is the essence of pears.

16. Acetic ether, treated first with sodium and then with iodide of ethyl, gives butyric ether ($C_6 H_{12} O_2$), the essence of pineapples. For other synthetized products similarly obtained and in prospect, *see* Lecture, June 9, 1865, p. 2, *viz.:*

Propionic Ether	$C_5 H_{12} O_2$	Œnanthylic Ether	$C_9 H_{18} O_2$
Diethacetic Ether	$C_8 H_{16} O_2$	Margaric Ether	$C_{17} H_{34} O_2$

17. From propylic alcohol, glycerine ($C_3 H_8 O_3$) the sweet principle of animal fats can be obtained.

18. By the combination of glycerine with the fatty acids, synthetized according to No. 6, oils and fats similar to animal and vegetable oils and fats are produced.

19. By careful oxydation, amylic alcohol is converted into valerianic aldehyde; and this, treated with prussic acid (got from cyanide of potassium, *see* No. 10), is transformed into leucine ($C_6 H_{13} NO_2$), found in the spleen, pancreas, liver, bile, and kidneys, and in the salivary glands.

V. ANTHROPOLOGY.

1. *Lectures on Man: his Place in Creation and in the History of the Earth.* By Dr. Carl Vogt. Edited by James Hunt, Ph.D. London, 1864.
2. *The Plurality of the Human Race.* By Georges Pouchet, M.D. Translated and edited by H. J. C. Beavan. London, 1864.
3. *Memoirs Read before the Anthropological Society of London.* Vol. I. 1863–4. London, 1865.
4. *The Anthropological Treatises of Johann Friedrich Blumenbach.* Translated and edited by Thomas Bendyshe, M.A. London, 1865.

The works, the titles of which we have placed at the head of this article, have been issued by the Council of the Anthropological Society of London, to their fellow members during the past twelve months, and may be accepted as affording a tolerably faithful representation, not only of what the Society has accomplished during that period, but what are the tendencies and objects of its principal members.

We have heard or read somewhere, that if a number of young men, with some small share of ability, were to unite together and form a society, one of the leading rules of which should be to lose no opportunity of sounding each other's praises, the world might in process of time be almost brought to believe that a new and dazzling coruscation of talent had blazed forth, and that a fresh and startling revelation would shortly be announced. This seems to be the principle on which the leading members of the Anthropological Society of London have acted, such the process by the agency of which they seek to reach the Temple of Fame. Accordingly, we find the President, Dr. James Hunt, quoting, and of course with much approbation, the sayings and doings of the Assistant-secretary, Mr. C. Carter Blake. Member of Council, Mr. Beavan, is equally complimentary; and so the pleasant and highly-seasoned ball of flattery is tossed to and fro between President and Vice-president, Secretary, Treasurer, and Member of Council, though, we must confess, we are unable to see what these gentlemen have either said or done to merit so much laudation as they lavish on each other.

Vogt's work on Man consists of a series of lectures delivered at the request of the Useful Knowledge Society, of the Canton of Neufchâtel. It is written in a popular form, and discusses the interesting problems of man's antiquity on earth and his relations to the lower animals, which have been rendered so familiar to the English public by the recent writings of Darwin, Lyell, and Huxley, and by the many controversies and discussions to which they have given origin. Hence those who have kept themselves at all on a level with these subjects will not find much that is new in the work before us, and we are somewhat at a loss to understand why these lectures, however well they may be adapted to place a German-speaking audience *au courant* with these problems, should have been selected by the Council of the Anthropological Society for translation and publication to their members; for we should have supposed that the members of a society which professes "to investigate the laws of man's origin and progress," would not have required to go to a foreign source for information on these topics, but would have made themselves acquainted with the writings of the most important at least of those men of science in this country who have communicated their speculations to the world, and with whom indeed it may be said that most of the recent theories and surmises on these subjects have originated.

We should not, however, have pressed this objection to the translation of Vogt's Lectures if, after perusal of the book, we had felt that the argument had been fairly stated, and that a spirit of candour and a desire to seek for the truth, even though it might at first sight seem to be opposed to the predilections of the author, had pervaded its pages.

When the man of science enters on the physical investigation of a subject, which goes so far back in the history of the world as the first appearance of man upon earth, every step should be taken with the utmost caution, every seeming link in the chain of evidence should be weighed and tested with the greatest care; for though man's advent may not date from the dawn of time, and though he may not be able to claim an antiquity comparable to that of the *Eozoon canadense*, yet the tendency of all recent inquiry is to throw him much farther back than was at one time supposed, and to make him a contemporary of animals long since extinct, so that man, as he first appears in written history, is, compared with man primeval, but as a creature of yesterday.

Vogt is a most strenuous advocate for this extended antiquity of the human race, and he has given a very readable account of the various localities in which human bones, or objects apparently the work of human hands, have been met with under circumstances which manifestly point to a high antiquity. But in his desire to prove his argument, he has not exercised sufficient discrimination in the selection of his cases, and has accepted as evidence certain supposed proofs which have not stood the test of a rigid investigation. We may refer more especially, in support of our statement, to his account of the much talked of Moulin-Quignon jawbone, the authenticity of which he accepts without hesitation, although some of our most distinguished English palæontologists are unable to accept it as genuine. Again, he pronounces the Engis Cave skull, respecting the antiquity of which there seems to be no question, to be "one of the most ill-favoured, beast-like, and simious skulls we know of," though we must confess we see nothing in its form to justify such an opinion; and we fully coincide with the statement made by Professor Huxley, that there are no marks of degradation about it. But Vogt is a firm believer in the descent of man from the simious group standing next him, and therefore it suits his purpose to make out that the crania of the primeval races possessed an ape-like form. In his desire to believe anything which may seem to lend support to his argument, Vogt displays a readiness which stands out in marked contrast to the scepticism he displays upon other subjects which most men, at least in this country, are accustomed to hold in reverence, and to treat with consideration and respect. There are so many sins against good taste, so much that is offensive in the lectures, that some slight qualms of conscience as to their applicability to the tastes of the British public seem even to have affected the not very fastidious editor, Dr. James Hunt, for he confesses in his preface, "that at first I omitted a few passages which I did not think in good taste, but on proceeding with my labour I found that to cancel all the passages which might offend would be entirely to alter the character of the work." On re-consideration, therefore, he has effected a compromise, and, like the ingenious editor of a copy of the epigrams of Martial we once met with in our school-days, he has struck out of the text some of the more ribald passages and has printed them as an appendix, where, in a concentrated, and, let us hope, nauseating form the reader may have the opportunity of perusing as choice a collection of scientific Billingsgate as is to be found in the English language.

M. Pouchet's work, "On the Plurality of Races," is on a subject which has of late years, more especially in France and America, attracted considerable attention. In the former country it has been discussed with much ability by various distinguished men of science, and all that can be stated on the subject in the present condition of our knowledge seems to have been said by the advocates of one or the other side of the question. M. Pouchet, as the title of his essay would indicate, is a strenuous supporter of the descent of man from more than one primitive stock. Moreover he scouts the idea of a distinct human kingdom, and considers that the physical and psychological differences between man and the apes are not of kind, but merely of degree. He considers man to be comparable in all points with animals, and that a common origin ought to be sought for him and them. He laughs at the notion of a creation, and finds this common origin "in a mass of amorphous matter, which at a later period will form itself, or in the midst of which will be *spontaneously* developed, an anatomical element, that is to say, an organized body." Though how the "mass of amorphous matter" was itself formed, or what were the forces or agencies which induced the development of the "anatomical element" in it he does not condescend to tell us. Of such and similar loose assertions the essay is in a great measure composed, and the number of facts which the author advances in support of his statements, is so small that one is tempted to exclaim with Prince Hal, "O monstrous! but one half-pennyworth of bread to this intolerable deal of sack!"

The volume of memoirs issued by the Anthropological Society consists of the most important papers read before it during the Session 1863–64. The first on the list is by the President, "On the Negro's Place in Nature;" but as it has already been noticed in the pages of this Journal, in connection with the meeting of the British Association in Newcastle, we need not allude to it further. Then follows a short but interesting paper by Dr. Peacock, in which are recorded the results of some observations on the weight of the recent brain in four negroes. His observations "tend generally to support the conclusions of Sir William Hamilton and Professor Tiedemann, that there is no very marked difference between the ordinary size of the brain in the African and the European; but they certainly indicate that the brain is usually somewhat smaller in the former race than in the latter." Mr. Bollaert contributes three elaborate papers "On the Astronomy of the Red Man," "On the Palæography of America," and "On the Past and Present Populations of the New World." As showing the great destruction of the aboriginal population, he states that the number of natives at present inhabiting the great western continent is probably not more than between ten and eleven millions, whilst at the time of the discovery of America in 1492, the population was over 100 millions. Messrs. Thurnam, Davis, and C. C. Blake furnish each a memoir on craniological subjects. Dr. Thurnam's is on ancient British and Gaulish skulls, a subject on which no man is more fitted to speak with authority. To attempt anything like an analysis of this very exhaustive paper in the space at our disposal is impossible. We may, however, cite the general conclusion he has arrived at, that there is proof of a succession of two primitive races—a long-headed and a short—in Britain in pre-Roman times, the dolicho-cephalous being the earlier of the two; but, as to France, he agrees with Carl Vogt in saying, "the farther we go back, the greater is the contrast between individual types, the more opposed are the characters,—the most decided long-heads immediately by the side of the most decided short-heads."

In a short memoir, entitled "Notes on certain Matters connected with the Dahoman," Captain Richard F. Burton congratulates his fellow-members that a society has at length arisen, in which a liberty of speech and a freedom of thought hitherto unknown in Great Britain is enjoyed, and then proceeds, evidently *con amore*, to give an account to his brethren of the filthy customs of the degraded negroes of the kingdom of Dahome. Mr. W. T. Pritchard follows in the same track, with a description of some practices, equally foul, pursued by the Samoan islanders; both these writers apparently having the idea that the leading function of this science of Anthropology, which they profess to promote, is to exhibit man in his most brutal and degraded aspects, and to avail themselves to the full of that "liberty" of speech which they believe to be the marked feature of the Society. And as an illustration of the reckless way in which another writer makes a statement, without advancing a shadow of proof in its support, we may refer to a paper "On the Phallic Worship of India," by Mr. Edward Sellon, in which it is stated that "there would also now appear good ground for believing that the ark of the covenant, held so sacred by the Jews, contained nothing more nor less than a Phallus, the ark being the type of the Argha or Yoni."

Of the last volume we need say no more than that it is principally made up of a translation of the treatise of the distinguished anatomist and physiologist, Blumenbach, "On the Natural Variety of Mankind," and of a translation of an inaugural dissertation on the same subject, written in 1775, by a certain Dr. John Hunter, an Edinburgh graduate, who is not, our readers must bear in mind, *the* John Hunter, who founded the great museum in Lincoln's Inn Fields.

VI. THE PROGRESS OF ZOOLOGY.

The Record of Zoological Literature, 1864, *Vol. I.* Edited by Albert C. L. G. Günther, M.A., M.D., F.Z.S., &c. London: Van Voorst, 1865.

In the present age of thought and busy activity, when every department of science has so many diligent workers, the accumulation of facts is so vast and so rapid, that their arrangement into something like systematic order is a real boon to the scientific investigator. The Year Book is now a recognized part of our literature, and the compilation of such laborious productions is of greater or lesser service according to the amount of intelligence and method brought to bear upon the collection and arrangement of the material. The greater the simplicity that can be introduced into such a digest the more valuable it becomes for reference, but it requires powers of mind of a superior order to condense and arrange upon a simple and intelligent plan a vast and heterogeneous mass of materials, such as a crowd of ardent workers have been busy upon during twelve months over the civilized world. Such a task has Dr. Günther set to himself in the preparation of a volume which shall record the labours of zoologists during the year 1864, and we must confess that he has produced a work which cannot fail to prove of the utmost service to all zoological investigators. The quantity of printed scientific matter here condensed amounts in the aggregate to upwards of 25,000 pages, a sum which it would be obviously impossible, independently of other reasons, for one man duly to chronicle with accuracy; and the work before us has therefore been wisely distributed among a number of gentlemen well known in the departments they respectively represent. Throughout the whole, however, the editor has aimed at unity of plan, and has well succeeded on the whole in securing it, although it is natural that a certain complexion is given to each record "according to the individuality of the recorders." To secure this uniformity, however, it was recommended that each record should commence with a general list of the various publications, while the second part of the record should be of a more special character, containing abstracts of important papers, more particularly of those which are difficult of access. Abbreviated diagnoses of new species were to be given with exact references and fuller descriptions when occurring in little-known journals. All anatomical papers were to be mentioned, but only those directly bearing on classification, specific definition, or the life history of an animal were to be more specially treated. Nor were sound popular works to be omitted in the category, a determination which we think was arrived at with wisdom and liberality.

Dr. Günther himself undertakes the Mammalia, among which Dr. Gray and Mr. Flower appear to have been the most diligent workers in this country, and Peters and Van der Hoven among continental zoologists. Considerable prominence is given to Dana's method of classification on the principle of cephalization of the body, that is, the subordination of its members and structures to head-uses; and the order *Cetacea* appears to have benefited most by researches during the past year. We may regard this first instalment by the editor as a model record, in which it is a matter of extreme facility to discover any point which the investigator is desirous of arriving at, or any paper which he may wish to consult. Having set so excellent an example, we shall hope to see it generally followed in future volumes of the 'Record,' as far as the complexity and vastness of the material of certain departments will allow.

Mr. Alfred Newton, to whom was confided the class Aves, has, we think unfortunately, departed somewhat from this simplicity, on which the main value of the 'Record' depends. In his general list at the commencement, instead of following a generally understood order of arrangement, he at once splits up his matter into regions, Palæarctic, Œthiopian, Indian, Australian, Nearctic, and Neotropical, followed by other subdivisions of descriptive Anatomy, Pterylography, a newly invented term, *Neossology*, and Oology. If the work is intended solely for professed ornithologists, perhaps this division may be considered to have its advantages; but to persons not familiar with Dr. Sclater's geographical distribution of birds, these divisions are somewhat puzzling, and necessitate a hunt through the whole, the divisions being at least useless. In the special part of this subject the same divisions are used, which would save further trouble if the paper is found in the first list, but which is otherwise open to the same objections. We do not doubt that Mr. Newton has used his best judgment in this mode of treating his department, but we would suggest that it is capable of improvement. Among birds, our ornithologists, Gould, Sclater, Wallace, Salvin, Swinhoe, and others, have left the impress of their labours, and they are worthily supported by continental brethren, such as Hartlaub, Pelzeln, Rosenberg, and others. As we might suppose, from their numbers, the Passeres have received the greatest amount of attention and the largest accessions, though every other order has made steady and interesting advances. One of the most interesting ornithological events of the year was the exhibition, by Mr. Thomas Allis, of York, of the very recent remains of a Dinornis robustus, at a meeting of the Linnean Society. This bird had been found in a sand hill, about 100 miles from Dunedin, in the middle island of New Zealand, and in such preservation that a considerable portion of the outer skin, studded with the quill part of the feathers, remained.

No one could be more fitted to record the progress of Herpetology than Dr. Günther himself, this being his own special subject; and the same remarks apply to this portion of the work which were made with reference to the record of Mammalia. The chief work of the year in this department is undoubtedly Dr. Günther's elaborate memoir on the "Reptiles of British India," published with twenty-six most beautiful and life-like plates, by the Ray Society. In this work he describes no less than 526 species, many of them new. Besides this great work, several minor contributions are from Dr. Günther's pen. Dr. Gray has also been very prolific of papers in the systematic department of this subject. It appears that the number of reptiles known has much increased of late years, and Van der Hoven's estimate of 1,500 species is regarded as much too low. The Chelonia have received much elucidation from Dr. Gray, more particularly the Asiatic and African species of freshwater turtles. Mr. Cope, of Boston, and Dr. Günther have been the chief investigators of the Saurian reptiles. Peters, Dumeril, and Günther, of the Ophidians. The question of the position of the Amphibia with regard to reptiles has been again raised by Dana, and the view seems to obtain favour from Dr. Günther, that Amphibians form a distinct group in the class of reptiles—a view which is strengthened by the analogy drawn from other classes of Vertebrata; the Mammals have their *inferior* subdivision, the *Oötocoids*, or semi-ovoviviporous species (Marsupialia and Monotremata); the birds have *their* inferior sub-division, the *Erpetoids* (Archæopteryx), and between ordinary Reptiles and Fishes there are Amphibians, forming a similar hypo-typic subdivision of reptiles.

The editor of the 'Record' has taken his share of the work, and appears also as the compiler of the copious article on Fishes, a subject in which he is also a great authority. His catalogue of the fishes of the British Museum is an important monument of his labours in this division of Zoology. In this catalogue, which forms a complete handbook to Ichthyology, all the species known are described and systematically arranged. Up to the present time, five volumes of this catalogue have been published, the first three containing the 3,481 species of Acanthopterygii at present known, the fourth and fifth describing nearly 2,000 other species; but the work is still incomplete, upwards of 8,000 species being known, nearly equally divided between freshwater and salt. But in the European fauna, the ratio between freshwater and marine species is as one to three. Another important work is a collected account of the Ichthyology of the East Indian Archipelago, by M. P. Bleeker, published by the Dutch government. Four volumes in folio have appeared. Dr. Bleeker has spent twenty years in this study, and the present work is chiefly a republication of descriptions, accompanied by very accurate plates from drawings made in India. The fishes of Finland, too, have been described by Herr Malmgren, who propounds theories of the specific identity of the different European Salmonoids, which are strongly combated by the editor. Among the contributors of papers to the literature of Ichthyology, Dr. Günther, Mr. Gill, and Dr. Bleeker figure conspicuously; and Mr. Gill's theory of the typical Leptocephali being the larval form of young congers, coupled with Agassiz' views of the metamorphoses of fishes, is not the least noticeable part of their history to which attention has recently been called. Mr. Gill promises a more extended memoir upon this subject, and the avowed purpose of Agassiz' journey to South America is to study the metamorphoses of the fishes of the Amazon, so that we may hope for more light upon this very remarkable subject.

The article upon "Mollusca" is supplied by Dr. Eduard von Martens, himself a copious contributor to the literature of the subject. By far the greater portion of the publications on this class of animals is devoted, observes Dr. Von Martens, to descriptions of species belonging to types more or less previously known, and more especially of their shells, as is usually the case in this department of Zoology. The most important work at present in progress is Lovell

Reeves' magnificent "Conchologia Iconica." The number of species of Mollusca recently described as new, but without indication of their habitat, is fortunately not large, so that our knowledge of the geographical distribution of the Mollusca is also advanced by most of these papers, especially by those in which an enumeration of all the species found in the same district is added. The faunas of Eastern Asia and Australia have been more particularly enriched during the past year. The systematic arrangement has not been essentially changed, but a considerable number of new genera (perhaps rather too many) have been introduced into science. The Cephalopoda and Pteropoda appear to have been entirely neglected. The Nudibranchiata have been well illustrated with new South American species, by Mr. Angas, and by the publication, by Messrs. Alder and Hancock, of the beautiful series collected by Mr. Walter Elliot, at Waltar, in the Madras Presidency; but the great mass of observations collected upon the Mollusca refer to the Gasteropoda.

The Tunicata and Polyzoa (Molluscoida) chronicled by Mr. J. Reay Greene, are chiefly illustrated by Dr. J. D. Macdonald and Mr. Alder, respectively. Dr. MacDonald is of opinion that the Molluscoida and Cœlenterata together form an unbroken series of animals to be placed between the Mollusca proper on the one hand, and the Protozoa on the other. The members of the group thus constituted, though developed from true ova, are prone to form compound organisms by continuous gemmation. In all, the movement of the circulatory fluid is effected either by ciliary action, or by a propulsive organ unfurnished with valves. Thus, starting from the Ctenophora (Beroë) as a central group, we proceed in two directions towards the Molluscoid or higher, and the Cœlenterata or lower, divisions of the series.

Mr. Spence Bate's Chronicle of the Literature of the Crustacea for 1864, enters, perhaps, more fully than any other into debated questions and interesting points of detail, and his summary of Fritz Müller's memoir on behalf of the Darwinian theory on carcinological grounds, is valuable. The principle of Müller is that the surest way to prove the correctness of Darwin's views would be to apply them to a particular group of animals, going as much as possible into detail. Such an attempt to set up one common pedigree, whether for the families of a class, or the genera of a large family, or for the species of a rich genus, and to trace out as clearly and comprehensively as possible their common origin, might either lead to contradictions in the theory which would demonstrate its error, or the theory might throw light upon the succession in which the various circles separated from the common type and from each other; or thirdly, although the experiment might fail, yet should it succeed, it would, from its independent and perfect character, be considered evidence of real value;

and to this conclusion he is led by his researches. The very curious investigations made by Dr. Hansen upon the auditory organs of the Decapod Crustacea, and the remarkable researches of Fritz Müller on Penæus, as well as some other of the interesting questions of crustacean metamorphoses, are very fully noticed by Mr. Spence Bate, and these abstracts of valuable papers very much add to the interest and utility of the record. Each division of the Crustacea appears to have been well represented by various investigators, the Cirripeds having perhaps received least attention.

Nearly one half of the Zoological Record is taken up by the laborious and careful account of the literature of the Arachnida, Myriapoda, and Insecta, prepared by Mr. W. S. Dallas, of York. We must congratulate the editor upon having secured the services of so careful and painstaking a coadjutor, for the labour exhibited in this part of the volume is truly immense, and the result of great service to the crowd of entomologists who appear to number in proportion to the host of insects upon which their attention is concentrated. This is a fortunate circumstance or otherwise the arrears of insect literature would be enormous, and Entomology would fail to keep pace with the other branches of Zoology. It is in this department, however, that the descriptions of species, and the minute attention to specific differences, preponderate over the more comprehensive views of material relations, and those zootomic studies which characterize the researches of most other zoological investigators; not, however, that philosophic entomologists are wanting—we should be sorry to imply that—but the tendency of the exclusive study of entomology appears to be the development of that microscopic eye which can readily detect minute shades of colour and variations of form, and which is useful in its way, although not of the highest character as an intellectual effort. We cannot therefore, owing to the great mass of material, here attempt to give anything like a general view of the researches made in Entomology proper, but will content ourselves with saying that a vast number of new species have been added to the lists, a great many new genera formed, and Entomology in general as a science considerably advanced. The various departments of Coleoptera, Hymenoptera, Lepidoptera, Diptera, Neuroptera, Orthoptera, and Rhyncota have each received a fair share of attention. Among the students of Arachnida our own countryman, Blackwall, occupies a prominent place, whose "History of the Spiders of Great Britain and Ireland" is the most noticeable contribution of the time.

The remainder of the articles in this 'Record' are comparatively brief, although by no means on that account unimportant. Mr. J. Reay Greene supplies the Rotifera and Annelids. Two papers only occur in the former, of which summaries are given; but the Annelids are, as might have been expected, better represented.

Besides an important work on the Setigerous Annelids, by Ernst Ehlers, which is in course of publication at Leipzig, several interesting and important papers by Baird, Kölliker, Van Beneden, and others, indicate that this somewhat neglected department is making progress. Kölliker finds numerous sensory organs upon the integument of certain Polychæta, in the form of variously shaped hairs and papillæ, to which nerves are supplied which subserve to tactile functions; and Semper takes note of similar tactile bodies in the form of horny-toothed rings connected with vesicular arrangements surrounding nerves in Sipunculi.

Dr. Cobbold chronicles the Helminths, a subject which, from its human interest, obtains a considerable share of notice. Dr. Cobbold's own excellent treatise is the first original work on Helminths which has issued from the English press, and contains a valuable bibliography of the subject. The Germans are the chief students of Entozoa, and a great work by Rudolf Leuckart on human parasites is now in course of publication. Besides these, Friedrich Mosler, Virchow, Althaus, Diesing, and others have contributed important additions to this department of Zoology.

Lastly, the Echinodermata again call forth Mr. Reay Greene. Under this head the researches of A. Agassiz on the Embryology of Echinoderms, and of Sars upon similar subjects, which being made entirely independently, yet well confirm one another, are worthy of especial notice. With regard to the grade of development, it is remarked that on Embryological grounds the Asterids with suckers rank above those with tentaculiform feet; those with four rows of suckers, above those with only two; those with complicated spines and plates, above those with smooth arms; and lastly, those with elongated arms, above starfishes whose outline is pentagonal.

Here, we regret to say, we must close this chronicle. We heartily sympathize with Dr. Günther in his disappointment, that the gentleman to whom were entrusted the Cœlenterata and Protozoa failed to keep his engagement; and that since this did not become apparent until after two months' waiting, it was then too late to find a substitute. The consequence, of course, is that this first volume of the 'Zoological Record' is incomplete. As far as possible the deficiency will be made up in the following year, but everyone must regret the fact. In conclusion, we are glad to bear our testimony to the extreme value of the volume before us, and we trust that the substantial encouragement given to it by the sale of this edition, will induce the editor to continue his useful labours, since any Zoologist who has come into possession of such a treasure would sadly miss it if it were not forthcoming in future.

VII. THE ORIGIN AND ANTIQUITY OF MAN.

On the Occurrence of Stone Implements in Lateritic Formations in various Parts of the Madras and North Arcot Districts. By R. Bruce Foote, of the Geological Survey of India. With an Appendix by William King, jun., B.A., of the Geological Survey of India. Madras. 8vo. 1865.

On the Asserted Occurrence of Human Bones in the Ancient Fluviatile Deposits of the Nile and Ganges; with Comparative Remarks on the Alluvial Formation of the two Valleys. By the late Hugh Falconer, M.D., F.R.S., For. Sec. G.S. Quart. Journ. Geol. Soc., vol. xxi., pp. 372–389.

Researches into the Early History of Mankind, and the Development of Civilization. By Edward Burnet Tylor. London: Murray. 1865.

Prehistoric Times; as Illustrated by Ancient Remains and the Manners and Customs of Modern Savages. By John Lubbock, F.R.S., V.P.L.S., F.G.S. London: Williams and Norgate. 8vo. 1865.

The Origin and Antiquity of Man are subjects which have of late years acquired the highest interest and received the greatest attention, through the discovery, in stratified and undisturbed deposits in France and England, of works of art associated with the remains of extinct animals. These discoveries are so well known, that it is unnecessary for us to review the general question; we shall therefore merely notice a few of the recent publications of more than ordinary importance; and it accidentally happens that their scope and character enable us to discuss more particularly a limited and most interesting portion of the subject.

Since the acceptance of M. Boucher de Perthes' views of the nature and age of the flint implements of the valley of the Somme, the search for similar instruments elsewhere has been prosecuted with remarkable enthusiasm. From the title of Mr. Foote's memoir, it will be seen that even the Asiatic continent has now yielded evidence that man existed in tropical regions at a period anterior to the formation of the existing physical features of the country. We know, within comparatively narrow limits, the age of the valley-gravels of France and England, and assuming that they indicate approximately the period of man's advent in Europe, the question will naturally arise,—At what period of the world's history did man first appear in India?

The extension into Asia of the known range of ancient flint implements, or corresponding weapons, was long preceded by the promulgation of the late Dr. Falconer's hypothesis that the gigantic fossil Tortoise of the Sewalik Hills may have lived contemporaneously with man in India. This speculation (which its author has re-enunciated in the paper whose title we have given above), the consequences which result from its acceptance, and from the acceptance of the arguments used in supporting it, are what we shall chiefly consider in this notice, the more especially as Mr. Foote's pamphlet has a direct bearing on its probability, as well as being an important addition to our knowledge. It must be stated, however, that this hypothesis is avowedly nothing more than suggestive; and whatever its ultimate fate may be, its lamented author's memory will not lose by its promulgation any of the lustre with which his name is now invested, for the idea of a Miocene man has already been adopted by some of the highest authorities on the subject, though rejected by others.

In endeavouring to estimate the bearing of known facts on its probability, we have arrived at somewhat adverse conclusions, but they are given with the highest admiration of the ingenuity displayed in the conception and elaboration of the idea, and of the genius of the naturalist who advanced it.

Of Mr. Tylor's book we ought to say at the outset that it is a work of very great interest and ability; the facts contained in it are brought together from various sources, but a large number of the inferences drawn are original. In the department of Comparative Mythology, the author's division of legends, traditions, and the like into Historical Traditions, Myths of Observation, and Pure Myths would be useful, if the separation were more easy to make in practice. His chapter on the Geographical Distribution of Myths is also very instructive, although he often seems to draw a conclusion from insufficient evidence. We cannot help remarking, also, that although a ludicrously inconsequential argument may, when skilfully employed as an illustration, create an impression that another train of reasoning is fallacious, it by no means proves that such is the case.

Mr. Lubbock's book consists of a series of essays and lectures which have been published to a greater or less extent before; it treats chiefly of a more ancient period in the history of man than Mr. Tylor's, to which it forms a useful introduction, though scarcely of equal scope and originality.

The gigantic extinct Tortoise of the Sewalik Hills (*Colossochelys Atlas*) was discovered in the Miocene deposits of those mountains by the late Dr. Falconer and Captain (now Sir Proby) Cautley; it was described by them in 1836, but the detailed account of it was not published until 1844; it is believed to have possessed a shell 12 feet long, 8 feet in transverse diameter, and 6 feet high! In the Proceedings of the Zoological Society for 1844, Dr. Falconer speculated on the date of the extinction of this gigantic animal, and he reproduces in his paper just published the more cogent of the arguments he then used, with others which serve further to elucidate his meaning. Dr. Falconer's strong point is the existence of traditions of a gigantic tortoise, comparable in size with the elephant, connected with the cosmogonic speculations of nearly all eastern nations, and he asks, "Was this tortoise a mere creature of the imagination, or was the idea of it drawn from a reality like the *Colossochelys?*" If the latter part of the question be answered in the affirmative, then the inference seems plausible that the *Colossochelys* may have co-existed with man.

Mr. E. B. Tylor considers* the whole story of the World-tortoise to be a "Myth of Observation;" he also shows that it exists in the New World, and states† that this occurrence of the tradition in the two hemispheres "leaves not the least opening for the supposition of its having been carried by modern Europeans from the Old to the New World." In his opinion also‡ the various stories of the World-tortoise may be resolved into the conception of the world as "a flat plain over which the sky is placed as a dome, as the arched upper shell of the tortoise stands upon the flat plate below."

On the other hand, Dr. Falconer brings forward a considerable amount of cumulative evidence in support of his hypothesis. He shows that in the Pythagorean cosmogony and in the Hindoo mythology reference is frequently made to different animals of extravagant magnitude, but whose conception may all (except the Tortoise) be traced to an exaggerated idea of the largest animals now existing in India; and he sums up as follows:§—"We have the elephant, then as at present, the largest of land animals, a fit supporter of the infant world; in the serpent *Asokee*, used at the churning of the ocean, we may trace a representative of the gigantic Indian *Python*; and in the bird-god *Garūda*, with all his attributes, we may detect the gigantic Crane of India (*Ciconia gigantea*), as supplying the origin. In like manner the *Colossochelys* would supply a consistent representative of the Tortoise that sustained the Elephant and the world together. But if we are to suppose that the mythological notion of the Tortoise was derived, as a symbol of strength, from some one of those small species which are now known to exist in India, this congruity of ideas, this harmony of representation would be at once violated. It would be as legitimate to talk of a rat or a mouse contending with an elephant as of any known Indian tortoise to do the same in the case of the fable of *Garūda*."

This evidence is drawn from the most questionable of sources; and although we quite agree with Dr. Falconer in the opinion that "Geology has never disdained to draw upon any department of human knowledge that could throw light on the subjects which it investigates," we cannot but think that he strains the principle to the utmost by calling mythology a "department of human *knowledge*." But accepting the evidence and the conclusion, what follows? Dr. Falconer nearly thirty years ago stated as his opinion "that the *Colossochelys* may have lived down to the human period, and become extinct since;" and he now says that this view is "reciprocal" with the one "that man had lived back to be a contemporary of the Tortoise, now proved to have been Miocene." He also urges "that the form of expression selected on the occasion was that which was least calculated to provoke ridicule, or to shock the strong prejudices on the subject which were then dominant among educated men." We should not have considered Dr. Falconer so susceptible of ridicule, so careful of offending popular prejudices, or so little amenable to the necessity of a scientific man saying and writing exactly what he means, had it not been for the publication of this sentence. His object in thus investing his writings with a reputation for ambiguity is simply to make out a good case in proof of his assertion that nearly thirty years ago Captain Cautley and himself were "occupied with the question of the remote antiquity of man in India." We are quite willing to believe that this was the case, for it is still fresh in our remembrance that it was Dr. Falconer, who drew the attention of Mr. Prestwich, Mr. Evans, and others, to the long-neglected specimens and opinions of M. Boucher de Perthes, and obtained for them the fair and careful consideration that resulted in establishing the views so long held by the distinguished Abbeville antiquary.

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* 'Early History of Mankind,' p. 305.

† P. 336.

‡ P. 333.

§ P. 385.

From the foregoing quotations, however, it appears certain that the late Dr. Falconer was of opinion that the advent of man may have taken place at so remote a period as the Miocene, though "partly from considerations of a different order." To these considerations we shall presently refer; but before doing so we must ascertain what support is yielded to his view by the discoveries detailed in Mr. Foote's pamphlet.

Very little is known of the geological age of the implement-bearing formations of Madras and North Arcot; but in the districts of Trichinopoly and South Arcot deposits supposed to be identical with them are found resting unconformably on Cretaceous strata, and overlain by the alluvium of certain rivers. All the implements, several hundreds of which have been found, are made of quartzite, which substance, Mr. Foote tells us, is the best substitute for flint in the Madras district. In form these implements correspond with many of those found in the valley-gravels of France and England; but, as will be seen by a comparison of Figs. 1, 3, 5, and 7, with Figs. 2, 4, 6, and 8 in the Plate, the Indian specimens are much less elaborate. Without an examination of a large number of specimens it would not be safe to decide whether this difference is owing to the comparative toughness of the quartzite, or to the Indian implements having been made by a less cultivated, and therefore, very possibly, a more ancient people.

Mr. Foote appears to be unacquainted with Dr. Falconer's speculation (even in the form in which it was published in 1844), as he makes no allusion to it, and mentions no facts having a direct bearing on the probable relation of the implement-bearing deposits to the Miocene period. To his mind the case is simply as follows:—Stone implements, comparable with the flint implements of Europe, occur near Madras in deposits probably identical with those which in neighbouring districts underlie the modern alluvium. Therefore the Indian deposits are contemporary with the European, and are of Quaternary age, if not more recent.

In Mr. Foote's opinion, these deposits, which are composed of Lateritic conglomerates and sands, "were deposited at the bottom of a shallow sea studded with mountainous islands, between which flowed strong and rapid currents." These islands are supposed to have been either "inhabited or visited by the people who made the quartzite implements which are at present the only record of their existence." The greatest height at which quartzite implements have been found is 370 feet, so that a considerable period of time must have elapsed since the formation of the deposit in which they occur; and presuming that the alluvial deposits overlying them are to some extent synchronous with the oldest alluvium of the valley of the Ganges, we get a more or less probable measure of their antiquity. But the lapse of time thus indicated by no means carries us back to the Miocene period, as the essentially superficial Lateritic deposits can hardly be correlated with the highly inclined Sewalik strata.

It therefore appears that from the positive facts now in our possession we are not justified in assigning a period so remote as the Miocene for the advent of man in India. We must therefore return to those "considerations of a different order" to which we have before alluded.

Dr. Falconer writes, "It is not under the hard conditions of the Glacial period in Europe that the earliest relics of the human race upon the globe are to be sought. . . . It is rather in the great alluvial valleys of tropical or sub-tropical rivers, like the Ganges, the Irrawaddi, and the Nile, where we may expect to detect the vestiges of his earliest abode. It is there where the necessaries of life are produced by nature in the greatest variety and profusion, and obtained with the smallest effort; there where climate exacts the least protection against the vicissitudes of the weather; and there where the lower animals which approach man nearest now exist, and where their fossil remains turn up in the greatest variety and abundance."

Everyone must admit the justice of the remark that the earliest traces of man are more likely to be found in a genial than in a rigorous climate; but as regards the valley of the Ganges, according to Mr. Fergusson, but an insignificant portion of it was habitable at so recent a date as B.C. 3000. The last sentence refers to a different consideration altogether, and it will doubtless be asked by some, What bearing has it on the question? Why should we expect that man appeared first in those regions where the animals which approach him nearest now exist, and where their fossil remains turn up in the greatest variety and abundance? We are a little uncertain whether we have here a statement of extreme development opinions, clouded by the effort not "to shock the strong prejudices on the subject," which *are now* "dominant among educated men," or whether there be not some "reciprocal" view which we cannot perceive.

The probable origin of man could hardly fail to become a subject of speculation to those engaged in determining his antiquity; accordingly we find that several naturalists have ventured to tread on this very delicate ground. In his 'Prehistoric Times,' Mr. Lubbock has touched upon this subject, and it may be useful to cull from his pages two or three quotations containing expressions of the opinion of certain savants of eminence. Professor Huxley, for instance, has remarked that "the first traces of the primordial stock whence man has proceeded need no longer be sought, by those who entertain any form of the doctrine of progressive development, in the newest Tertiaries; but that they may be looked for in an epoch more distant from the age of the *Elephas primigenius* than that is from us." Sir Charles Lyell "thinks that we may expect to find remains of man in Pliocene strata, but there he draws the line." Mr. Lubbock combats this opinion, but does not advance any strong argument against it, though he eclipses everyone else in the candour with which he states his opinion. Thus, "it is true that few of our existing species or even genera have as yet been found in Miocene strata; but if man constitutes a separate family of mammalia, as he does in the opinion of the highest authorities, then, according to all palæontological analogies, he must have had representatives in Miocene times. We need not, however, expect to find the proofs in Europe; our nearest relatives in the animal kingdom are confined to hot, almost to tropical climates, and it is in such countries that we must look for the earliest traces of the human race."

Admitting Mr. Lubbock's premisses, man *may*, not must, have had "representatives" in Miocene times. Then "according to all palæontological analogies," the duration in time of a group of animals (whether family, genus, or order) varies inversely with its organization, so the family represented by man must have had a geologically short duration compared with that of other families of mammalia. The opinion contained in the last sentence quoted is identical with that expressed by Dr. Falconer, but it reveals more clealy the idea on which it is founded. At present man stands alone and quite isolated in the animal kingdom, and the certain records of his existence are as yet confined to Post-pliocene, probably to Post-glacial, deposits. We ought, nevertheless, to be prepared to receive facts which will extend his range in time, and lessen the gap between him and his "nearest relatives." Let us mention as two shadows, such as coming events cast before them, first, the discovery of markings on the bones of *Elephas meridionalis*, an animal of Pliocene age, supposed by M. Desnoyers and other naturalists to be of human production; and secondly, the discovery of a remarkable tooth, associated with remains of *Diprotodon*, &c., by Mr. Gerard Krefft, in an Australian cavern, which that gentleman describes as follows:*—"In shape it resembles the first of the premolar series of the lower jaw in man: the root, however, is much longer, the crown smaller, protruding, and considerably worn; the root is not smooth as in man, but somewhat ridged, with a few tubercles on the upper part." Mr. Krefft may well say, "I have no conjecture to offer as to which genus this tooth is referable."

EXPLANATION OF THE PLATE.

FIG. 1. Quartzite Implement from the Atrumpakkam nullah, one-half the natural size. (After Foote.)
" 2. Flint Implement from Icklingham, one-third the natural size.
" 3. Quartzite Implement from the Atrumpakkam nullah, one-half the natural size. (After Foote.)
" 4. Flint Implement from Milancourt, one-third the natural size.
" 5. Quartzite Implement from the Atrumpakkam nullah, unusually well made, one-half the natural size. (After Foote.)
" 6. Flint Implement from Abbeville, one-half the natural size.
" 7. Quartzite Sling Stone, from the Atrumpakkam nullah, one-half the natural size. (After Foote.)
" 3. Flint Sling Stone, from an Abbeville Tourbière, one-half the natural size.

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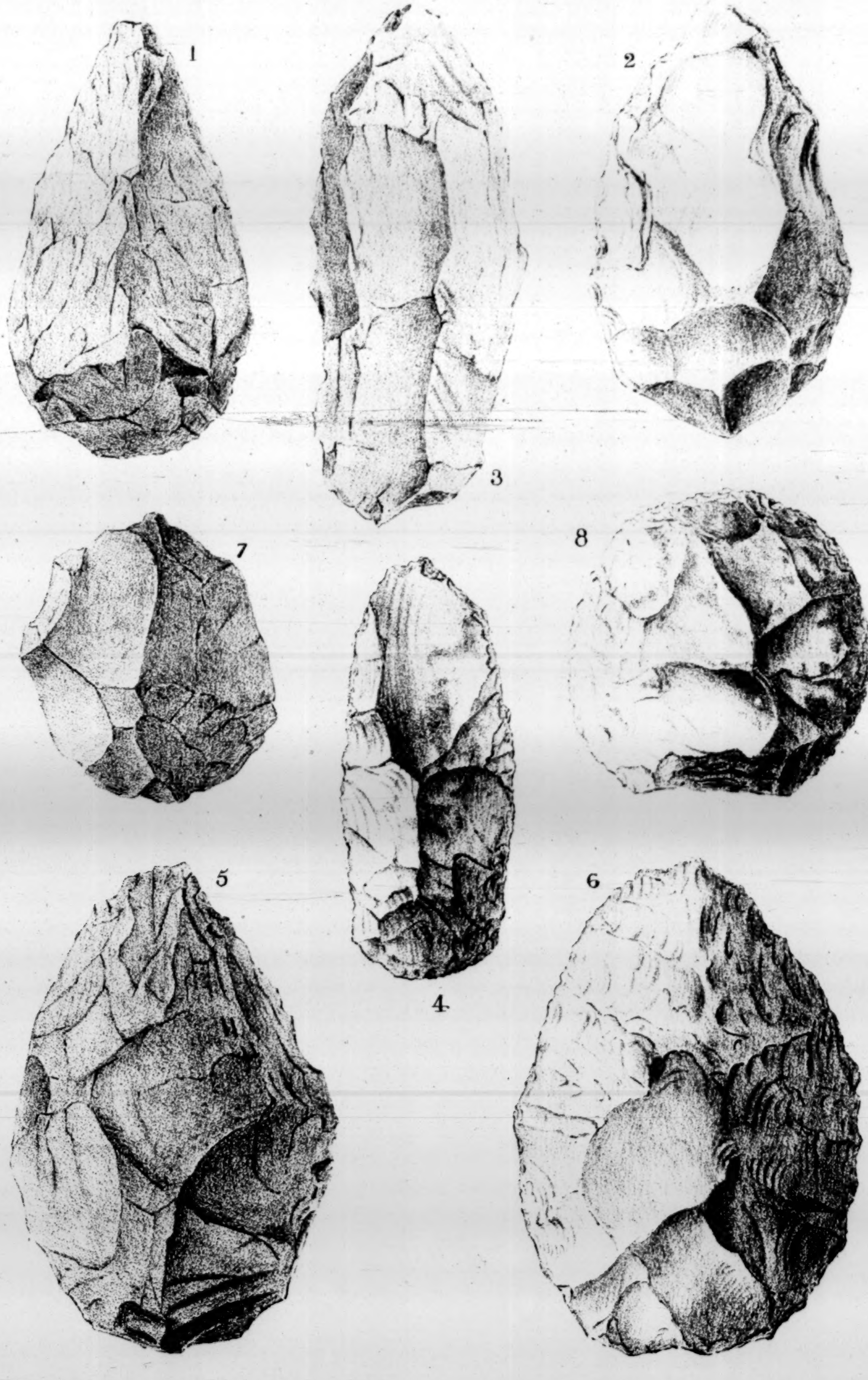
* 'Geological Magazine,' December, 1865.



De Wilde lith.

M & N Hanhart im

FLINT & QUARTZITE IMPLEMENTS.

VIII. HOFMANN AND MODERN CHEMISTRY.

Introduction to Modern Chemistry, Experimental and Theoretical; embodying Twelve Lectures delivered in the Royal College of Chemistry, London. By W. A. Hofmann, LLD., F.R.S., &c.

There is no more interesting study, and certainly none more instructive, than the inquiry into the progress of that knowledge which is acquired by the aids of science. To mark, where it is possible, the first gleam of a truth, to watch the flutterings of human thought around the little light, and to follow patiently its slow and gradual development, until man seizes it aright and chains it to do his bidding, is always a delightful exercise for the well-constituted mind.

We learn in contemplating the history of scientific discovery, that the search after Truth demands a large amount of labour continuously applied. A fact may be known for ages, and remain a barren fact because man fails to interpret it correctly. The Greeks, for example, knew *Electron*—amber—they were acquainted with the iron ore of Magnesia, and they were not ignorant of their peculiar powers of attraction; but more than two thousand years passed away before man learnt those laws regulating Electricity and Magnetism, by which he was enabled to apply them to useful purposes.

Every advance made by the Human family is due to the devotion with which some chosen member of that family has solicited nature to disclose her powers. The Earth, a mass of matter of wondrous constitution, rolling along its prescribed path in space, is man's abiding place. From it he must glean everything necessary for his healthful existence, and from it he must derive every source of finite happiness. Man's prescribed task is "to possess the Earth and subdue it," and the more zealously he bends his mind to the labour, the greater is the sum of his own enjoyment, and the more numerous are the advantages which he is enabled to bestow upon his kindred. As the chaotic Earth in its early darkness "was without form and void," and as at the touch of light it became a symmetrical globe, clothed with organized forms and radiant with beauty, so brute matter is seen to develop hidden powers, under the influence of the human mind, and become at the same time useful to man.

The history of the progress of civilization—surveyed apart from all the clouding influences of political contention, religious strife and national prejudices—resolves itself into a story of man's struggle with nature. We live in an age which will ever be remarkable as a period of action, during which the human mind is taxed to the utmost to make new applications of natural forces, and new combinations of nature's elements for the use of man. Existing in the midst of the mental strife, it is as difficult to discover the real order of progress, as it is for the soldier on the battle-field to learn the fortune of the day. We can, however, examine the road over which we have passed, can remember the names of the great men who have left their footprints deeply impressed for our guidance; and gathering experience from the teachings of the past, we may venture to predicate how the future will regard the present.

The science of Chemistry specially claims our attention at this time, as ministering extensively to the requirements of man, and adding greatly to his knowledge of natural phenomena.

At the commencement of the eighteenth century, Stahl put forward his doctrine of Phlogiston, for which, perhaps, the road had been prepared by Mayow.* A phlogistic system, however, was the dawn of a new day, and the rude empiricism of previous time perished before its light. The spirit of inquiry which arose upon the promulgation of this hypothesis gradually took form, and in 1777 we find Sir Torbern Bergman writing these remarkable words:—

"We have no knowledge of bodies *à priori:* every intelligence about them must be acquired by proper observations and experiments. But to discover and pursue such experiments, as really illustrate the point we are in search of, requires not only skill and a peculiar application, but also the most impartial love of truth; in order not to be ensnared by the pleasing desire of drawing general conclusions from a few *data* of precarious certainty. It lessens, no doubt, our trouble, and flatters our vanity, to be able to disclose in a moment the whole course of nature. Man is besides naturally indolent, and much inclined to be captivated by imagination more than by reality. The confession, therefore, *that we really know no more than what we know*, is,—even in our days when the experimental method is considered as the only right and true method,—very difficult and humiliating."†

Scheele, Lavoisier, and Priestly were, however, the first who introduced the exactness of Physics—the system of observation by weight and measure—into Chemistry; and from their times it may be regarded as a new science. These philosophers gave the world many truths as the result of their modes of investigating nature, and one of them, Lavoisier, taught a chemical nomenclature, which has aided, to the present day, in the ever difficult task of expressing new ideas in a form of words which shall convey a correct impression to the mind.

Prior to, and indeed for some time after this period, although

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* 'Opera Omnia Medico-physica, Hagæ, 1681.' 8vo. 'Dissertatione de Respiratione;' and also, Mayow's Diss de Salnitro and Spiritu Nitri Aereo.'

† 'Prefatory Introduction to Chemical Observations and Experiments on Air and Fire.' By Charles William Scheele. Translated by J. R. Forster, LL.D., F.R.S., &c. 1780.

Chemistry was making valuable discoveries in the mineral world, it had done but little toward elucidating any of the phenomena of the vegetable and animal kingdoms. Priestly had, it is true, discovered the influence of growing plants upon the air, and of light upon the growing plant.* Dr. Ingenhousz had observed the peculiar nature of the air "produced by a special operation carried on in a living leaf." And Sennebier found that plants yielded more "*dephlogisticated air*" (oxygen) in distilled water impregnated with "*fixed air*" (carbonic acid) than in simple distilled water.

All these men were floating round and gradually approaching the truth. Cavendish proclaimed that "fixed air is a principal constituent part of vegetable substances," but even he was bewildered by the Phlogistic Hypothesis, and it was not until Lavoisier destroyed it that any real advance was made.

Davy stands forth amidst the philosophers of his day as a remarkable discoverer. The brilliancy of his experiments, which proved the metallic nature of the earths and alkalies, and the elegance of those investigations which determined the true character of muriatic acid, has led his 'Agricultural Chemistry' to be almost forgotten. In this book, however, will be found the first clear exposition of the part which chemical forces play in all the processes of the living organisms, and an examination of the transformations and changes in plants and animals which are dependent on their influences. After Davy for a long period but small advance was made, and it is not a little curious to find Liebig in 1841 writing as follows:—

"Since the time of the immortal author of the 'Agricultural Chemistry,' no chemist has occupied himself in studying the application of chemical principles to the growth of vegetables, and to organic processes. I have endeavoured to follow the path marked out by Sir Humphry Davy, who based his conclusions only on that which was capable of inquiry and proof. This is the path of true philosophical inquiry, which promises to lead us to truth, the proper object of our research".†

It is not strictly true to say that Organic Chemistry had no existence between the time of Priestly and of Liebig. We find many chemists, as Pelletier, Vauquelin, Chevreul, Fourcroy, and others carefully examining the proximate principles of plants, and Berzelius gave the world his 'Animal Chemistry' within this period. But it must be conceded that until the Professor of Chemistry at Giessen taught Chemistry in its relations to organization and life, the study of Organic Chemistry lagged in the back-ground.

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* 'Experiments and Observations relating to various Branches of Natural Philosophy, with a Continuation of the Observation on Air.' By Joseph Priestly, LL.D., F.R.S. Birmingham, 1781.

† 'Chemistry in its Application to Agriculture and Physiology.' By Justus Liebig, M.D., F.R.S., &c. 1842.

The novelty of the views put forward by Liebig; the popular style in which he wrote on what had hitherto been regarded as a recondite subject; the enthusiasm which he threw into his lectures; the novelty and the completeness of his illustrations; the boldness, approaching to dogmatism, with which he propounded his hypotheses, all tended to make Organic Chemistry the favourite pursuit of the younger chemists.

The result has been, "that, during the last quarter of a century, the science of Chemistry has undergone a profound transformation; attended, during its accomplishment, by struggles so convulsive as to represent what, in political parlance, would be appropriately termed a revolution." These are the words of Hofmann, the favourite pupil of Liebig, who was sent forth from Giessen to teach in England the doctrines of the Master.

So thoroughly has Dr. Hofmann fulfilled his mission in this country, so entirely has he identified himself with 'Modern Chemistry'—which he has chosen indeed as the title of a valuable little work from his pen—that it has been thought important to sketch the progress of this chemist, and examine, as far as our space will admit of our doing so, the value of his discoveries and their bearings upon the present state of chemical science, and its applications to manufactures.

Augustus William Hofmann, whose name must be for ever connected with the history of chemistry during the last twenty years, is the son of John Phillipp Hofmann, a German architect of repute. He was born at Giessen, Grand Duchy of Hesse-Darmstadt, on the 8th of April, 1818. His early education was received in the Gymnasium of his native town. We learn that the father, who doubtless discovered the natural powers of his son, lost no opportunity of expanding the instruction given in that school. The study of classical languages claimed predominant attention in the Gymnasium, and feeling that the practical character of the age required other kinds of learning, the architect took his son on several lengthened architectural expeditions through France and Italy. The father and son were inseparable companions, and the former thought no sacrifices too great to ensure any benefit to his boy. The education at school and that of travel, produced in young Hofmann an inclination to the study of modern languages, and created a certain facility in using them, which did not remain without influence on his subsequent career. Liebig, who beyond most men has left his mark upon the age, began to draw the attention of Europe to the University of Giessen about the time—1836—when Hofmann entered it as a student. His first year was passed in studies of a somewhat desultory character. His father desired that he should become an architect, while his own predilections were towards philology. The elder Hofmann, evidently a practical man, earnestly opposed this course, as being unlikely to lead to any definite object, or to be attended with any profitable result. After a short contest, the law was selected as the profession to which the young Hofmann was to devote his attention, and for a few years, with considerable interruptions and, according to his own confession, without any great result, the study of the law claimed the future chemist. By a combination of circumstances, such as we not unfrequently find determining a man's course in life, this career was soon abandoned.

The chemical school of Liebig had attained its highest degree of development, and from all parts of the world, ardent pupils visited the University of Giessen, anxious to study under the auspices of the great master. Young chemists, many of them having been educated elsewhere, even Professors of Universities and schools, many of whom had been teaching for years, assembled in this little German town, which for a time became the chemical centre of the world. That which must be, *par excellence*, distinguished as Modern Chemistry had its birth here, and every student who left the laboratory in which Liebig taught, took "colour like the dyer's hand from that it works in," and spread the chemical philosophy of this school over Europe and America.

Liebig's laboratory was originally the kitchen of a barracks. It was now too small for the chemical class, and it became necessary to increase the working room. At first an additional wing was added to the old building, but ultimately it was determined that the whole should be reconstructed. The construction of the Giessen University laboratory was committed to the father of the young man, who was still wavering between law, philology, and architecture. The friendly relations which ensued between the architect of the new institution and Professor Liebig soon produced its effect upon the younger Hofmann. Once drawn within the influence of an attraction, which all who have been brought within its sphere declare to be irresistible, he felt impelled with extraordinary force towards the study of nature. From this period a new life commenced; the law studies rapidly fell into oblivion, the once favourite subject of languages claimed but an occasional hour of leisure, the whole time being devoted to the study of chemistry, physics, and mathematics.

Liebig's laboratory was the first independent institution of the kind in Europe, and it has served as the model for all subsequent structures devoted to the same end. In it we see young Hofmann in rapid succession working as a zealous student and participating in his revered master's researches as an expert assistant. It is not a little remarkable that even from his *début* attention was fixed upon the young chemist, and that his first investigation should prove to be the development of a fact, which has in his latest researches reached its mature form of an important practical application.

Hofmann's first published paper was the record of an investigation into the nature of the volatile bases of coal gas naphtha, amongst which Hofmann demonstrated the presence of ANILINE. This has become the starting point of a long series of researches which have richly benefitted both theory and practice. A second paper "On the Metamorphoses of Indigo," which finally settled the question of the substitution of chlorine for hydrogen (which at the time engrossed the attention of chemists) received the prize medal of the *Société de Pharmacie* of Paris.

At this time the *élite* of young chemical Europe, the founders of Modern Chemistry were working side by side in the Giessen laboratory, and Hofmann was the favoured assistant of the master. It would be difficult to conceive conditions more inciting to work for a young *savant* than this. With a far less powerful stimulus than this, the energetic assistant of Liebig would have made his position, but, surrounded by such influences, there is little doubt that his progress was considerably accelerated. Still this enviable position could not be more than a transitional one, an important stepping-stone to further progress. The time arrived when the young assistant, anxious to obtain an independent sphere of action, had to try the strength of his own wings. In the spring of 1845, the young chemist took leave of Giessen, of Liebig, and of a delightful circle of the nearest relations and most intimate friends, and became a private teacher in the University of Bonn. Here we find Dr. Hofmann lecturing on Agricultural Chemistry, and in a laboratory of the smallest dimensions he was busily engaged in following up his experimental researches; but his stay in Bonn was not to be of long duration.

The extraordinary development which the study of chemistry, and more especially of organic chemistry, had reached in Germany by Liebeg's teaching, was not without its influence in England. In the curriculum of the English universities at this time Chemistry played an essentially subordinate part. Public laboratories in which experimental researches could have been carried out by students did not exist. Even in London and Edinburgh it was difficult at that period to get admission into a scientific laboratory for the purpose of acquiring the practice of analysis, and it could only be done at considerable cost. Consequently the study of Practical Chemistry was accessible only to a limited few. This condition, however, was not to continue much longer, and it will be interesting to trace the causes, in their operation towards producing a sensible change. The British Association was doing its work in showing the thinking portion of the British public that science was needful to them, and that a great manufacturing people could not make any considerable advances without its aid. Young Englishmen had been amongst Liebig's students; they had drunk from the earnest teacher the draughts of enthusiasm, and they returned home to spread the chemical fever, under the excitement of which they lived. In 1841 we find the British Association desiring from Liebig a report on Organic Chemistry. This was furnished to them in 1842 at the Manchester meeting by Dr. Lyon Playfair. That all may judge of the estimation in which the German chemist was then held we quote the concluding paragraph of the abstract published:—

"In the opinion of all, Liebig may be considered a benefactor to his species, for the interesting discoveries in agriculture, published by him in the first part of this report. And having in that pointed out means by which the food of the human race may be increased, in the work now before us he follows up the chain in its continuation, and shows how that food may best be adapted to the nutrition of man. Surely there are no two subjects more fitted than these for the contemplation of the philosopher; and by the consummate sagacity with which Liebig has applied to their elucidation the powers of his mind, we are compelled to admit that there is no living philosopher to whom the chemical section could have more appropriately entrusted their investigation."*

Prince Albert, who had received all the advantages of a German education, and who, consequently, had studied many branches of science, was now making the influences of his mind felt in this country. The Prince had learned to regard a knowledge of science as an essential element in a liberal education, and seeing the want of that kind of knowledge amongst the people of the country of his adoption, he lost no opportunity of enforcing its importance. The following words express, at the same time, the true condition of the period, and the high standard to which Prince Albert desired to lift the public mind:—

"Nobody, however, who has paid any attention to the peculiar features of our present era, will doubt for a moment that we are living at a period of most wonderful transition, which tends rapidly to accomplish the great end to which indeed all history points; *the realization of the unity of mankind!* Not a unity which breaks down the limits, and levels the peculiar characteristics of the different nations of the earth, but rather a unity, the *result and product* of those very national varieties and antagonistic qualities.

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"Man is approaching a more complete fulfilment of that great and sacred mission which he has to perform in this world. His reason being created after the image of God, he has to use it to discover the laws by which the Almighty governs his creation, and by making these laws his standard of action, to conquer nature to his use—himself a divine instrument. Science discovers these laws of power, motion, and transformation; industry applies them to the raw matter, which the Earth yields us in abundance, but which becomes valuable only by knowledge."*

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* 'The Report of the British Association for the advancement of Science for 1842,' p. 42. The full Report was embodied in two works by Liebig—'Chemistry: its Application to Agriculture and Physiology;' and 'Animal Chemistry; or, Chemistry in its Applications to Physiology and Pathology.'

Those words were spoken in 1850, but as early as 1844 an association had been formed under the auspices of the Prince, which proposed to establish in London a practical school of Chemistry, founded on the model of Liebig's Laboratory at Giessen, the direction of which was to be placed in the hands of a young chemist educated under Liebig's eyes.

The Council of this Association, consisting of many noblemen and gentlemen, requested Professor Liebig to propose some candidates for the office to be created. Amongst those so named by the great German chemist was Dr. Hofmann, who, in the summer of 1845, received the invitation to undertake the formation of a new school of Chemistry in England. When it is remembered that the young chemical teacher of Bonn had never visited this country, it will be readily understood that he had some hesitation as to engaging in so arduous an undertaking. This was, however, very soon overcome by the personal interest which Prince Albert took in the matter, and through the influence of the Prince Dr. Hofmann obtained from the Prussian Government an indefinite leave of absence.

In October, 1845, we find Dr. Hofmann busily engaged in arranging a small and temporary laboratory in George Street, Hanover Square, in which the new school, under the title of *The College of Chemistry*, was opened in the beginning of November. How great a desideratum was actually supplied by the foundation of the school, and how correct the judgment of its projectors had been, became obvious from the rapidity with which the scarcely-opened laboratory was filled. So great was the number of students from all classes eager to avail themselves of the newly-offered facilities for engaging in the practice of Chemistry, that the promoters of the College felt at once the necessity of providing a more permanent and a more appropriate habitation for the school. The necessary funds were immediately contributed by some of the wealthy members of the Association; and, after the lapse of less than a year since its foundation, the operations of the school were transferred to a commodious building, which had been erected in Oxford Street. This well-known building, the Royal College of Chemistry, was in full work in 1846, and when we recapitulate the names of the men who were educated within its walls, and who have aided the progress of the science, it will be admitted that it has exerted a powerful influence on Modern Chemistry.

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* 'Addresses delivered on different public occasions by His Royal Highness the Prince Albert.' Published by the Society of Arts. 4to edition, p. 59.

In proof of this, we have but to refer to the list of chemists who have worked with Dr. Hofmann at the Royal College of Chemistry, at different periods, from its opening in 1845 to the present date, and who entertained him at a farewell banquet immediately before his departure for Berlin. The names of Abel, Church, Crookes, De la Rue, Nicholson, Odling, Perkins, figure here.* Beyond this gathering we remember those of Bloxam, Noad, Galloway, and several others who have made for themselves positions in the world of science.

Amongst those who contributed towards the funds for the establishment of the College of Chemistry were many who desired some substantial return for their money in the form of lectures, soirées, analyses, &c.; and not receiving those, such contributors withdrew their support. This rendered the financial position of the College for a period doubtful; but it ultimately emerged from all difficulties, through the devotion of a few faithful friends, whose names should be held in honour. Sir James Clarke, the late Lord Ashburton, Mr. Warren De la Rue, the late Mr. Dalrymple, and Dr. Bence Jones, stood in the first rank; and their efforts were supported by the determination of Prince Albert not to shrink from any sacrifice for the sake of consolidating the school which he had founded. While referring to this period of difficulty, it is pleasant to quote the words of Mr. Warren De la Rue as Chairman at the Banquet already referred to.

"Some of us know that the ability of the promoters to perform their part of the arrangement fell very far short of their anticipations, the very existence of the College being in fact in danger, and that Dr. Hofmann voluntarily gave up in succession—first, a portion of his salary, then his share of the student's fees, and lastly his house. Yet during this trying period he never, in the slightest degree, relaxed his efforts to establish the reputation of the College. He not only gave up the money which was his due, but, out of his extreme devotion to the educational objects of the College, abandoned for some years what to a German *savant* is of still greater importance, his original scientific investigations."

This statement is essentially important as showing the firmness of faith and purpose in Dr. Hofmann, who never for one moment lost hope in the ultimate success of the Institution which he was directing.

In 1849, Dr. Hofmann was elected a Member of the Chemical

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* 'Farewell Banquet to Dr. Hofmann.' A pamphlet record of this event, printed by Clowes & Sons.

Society, and on the 12th June, 1851, he was received as a Fellow into the Royal Society.

In 1853, the Chemical chair of the then recently established School of Mines, connected with the Museum of Practical Geology, became vacant by the resignation of Dr. Lyon Playfair. Sir Henry De la Beche, the Director of the School;—indeed the Founder of it; of the Museum of Practical Geology; and of the Geological Survey of the United Kingdom, offered this appointment to Dr. Hofmann. The Council of the College of Chemistry strongly urged their Professor to accept it, and they at the same time came to a resolution, to the effect that the object for which the College had been originally established having in a great measure been achieved, the College with all its property should be offered to the Government, to be incorporated with the Institution in Jermyn Street.

The negotiations to this end were carried out by the Office of Woods on the part of the Government, and brought to a satisfactory issue. Thus Dr. Hofmann became connected with the Royal School of Mines, without leaving his favourite laboratory in the College, which henceforth became the Chemical Department of the National Institution. This new position afforded Dr. Hofmann additional facilities to engage freely and largely in the experimental pursuits of his predilections.

As Dr. Hofmann has been enabled from 1853 to almost the present time, to carry on without disturbance his system of chemical instruction, and to pursue without the annoyance of the interference of shareholders his own researches, we will leave him in this happy position, endeavour to review his labours, and examine the extent to which he has aided in bringing about that state of knowledge comprehended in the term Modern Chemistry.

No inconsiderable portion of Dr. Hofmann's power arose from the zeal which he threw into his teaching; the pains which he took by enlivening experiments and new apparatus to bring forcibly to the eye of the student the facts and reactions he desired to impress on the mind. Although he never lost a strong German accent, he spoke our language with fluency and force; but the attraction of his style of lecturing consisted less in the language, than in the felicity of the illustrations, by which he endeavoured to bring the most abstract subject to the grasp of the popular understanding. He positively made the inanimate subjects he was dealing with live and act their several parts in the presence of his hearers, and he certainly was never greater than in the lecture-room. Hence his evening lectures in the Museum of Practical Geology, his lectures at the Chemical Society, of which he was president in 1861, at the Royal Institution, and elsewhere, always drew large audiences, who witnessed with pleasure and instruction the well-devised and successfully performed experiments. Even H. M. the Queen was pleased to listen to some of Dr. Hofmann's lectures, and he repeatedly had the honour of delivering short chemical courses to the Court at Windsor Castle and at Osborne.

Nothing can show more completely Dr. Hofmann's power of rendering an abstract subject pleasing than his lecture delivered at the Royal Institution on the 7th of last April "On the Combining Power of Atoms." In this lecture, which has been printed with wood-cuts, Dr. Hofmann introduced an entirely new mode of illustrating the subject. "I will," he says, "on this occasion, with your permission, select my illustration from the most delightful of games, *croquet.*" He makes croquet balls represent the atom, and the atoms of different elements are distinguished by different colours. He adds another mechanical contrivance to indicate the combining power of the atoms; this is effected by screwing into the balls metallic pegs, by which they can also be joined so as to rear mechanical structures in illustration of the atomic edifices to be illustrated. "Thus the hydrogen and chlorine atoms, which are *univalent* atoms, have each *one* arm, representing one combining or attraction unit; the atom of oxygen, a *bivalent* atom, has *two*, representing two attraction units; while the nitrogen and carbon atoms, respectively *trivalent* and *quadrivalent*, are provided with *three* and *four* arms, indicating the three and four combining units respectively distinguishing the atoms." By fixing those balls together in the order in which experiment has proved to us they combine, visible representations of the compounds which result from their combination are produced. In this way instruction is afforded by reaching the mind through the eye, which would never so readily have found ingress through the portal of the ear.

From the first Dr. Hofmann fully appreciated his task. He knew that to make the College of Chemistry successful and to establish for himself a name in England, his teaching must be made to tend to practical results. While he never flinched from impressing theory on the minds of his pupils, he made them all practical workers. They learned as much by what they saw passing before them as by their own actual manipulation. Dr. Hofmann has been particularly and truly characterized by his power not only of getting into the minds of his students the utmost amount of knowledge, but by his kindly encouragement, getting the most out of them for the advancement of science. As an example of this, during the last few years Dr. Hofmann has been entirely engaged in the elucidation of the chemistry of the new coal-tar colours which have attracted so much attention. This industry has in a great measure emanated from the Royal College of Chemistry; most of those who first engaged in this new branch of applied chemistry, Messrs. Perkin, Nicholson, Maule, Simpson, Medlock, and others were pupils of the College. While Dr. Hofmann has been earnestly engaged in working out the theory of this interesting subject, he has not forgotten its practical application. The beautiful red colouring matter known as Magenta was first observed and described by him, although he never produced it on a commercial scale. Again, the splendid violet, so much in vogue at present, is a discovery of Dr. Hofmann's, who produced it by the action of iodide of ethyl upon Magenta. It is a curious coincidence that the same agent which contributed so much, as will presently be seen, to his scientific successes, should also assist him in a brilliant industrial achievement.

We must now sketch, although we can do so but briefly, the progress of scientific inquiry in Dr. Hofmann's hands.

By continuing his researches on Aniline and its derivatives, he worked step by step to a clearer conception of the relation in which these substances stand to ammonia. He proved the volatile bases to be compound ammonias, derived from ordinary ammonia gas by the substitution of compound atoms consisting of carbon and hydrogen, for either one, two, or three of the hydrogen atoms in ammonia, and he gave a method as general as simple for the artificial construction of an endless variety of these substances.*

These researches have exercised a powerful influence upon the progress of Chemistry both practical and philosophical. Iodide of ethyl, in general the iodides of the alcohol radicals, with the aid of which the new reactions were accomplished, appear in these researches for the first time as agents of the substitution of compound hydrocarbon atoms for hydrogen, and substances which had been seen by few chemists at that time, became at once some of the most frequently employed agents of research. Ever since the publication of Dr. Hofmann's Memoirs, these agents have played a most important part in all researches in Organic Chemistry, by which the most interesting theoretical questions have been elucidated, and these agents are now manufactured upon a colossal scale for industrial purposes.

Nor was the influence of this investigation upon the general progress of Chemistry less marked in Dr. Hofmann's researches on Ammonia, in which he exhibited this substance as the source of an unlimited number of derivatives similar in construction but modified in properties. In these researches we find the first germ of the theory of types which subsequently in the hands of Gerhardt, Williamson, and others assumed a more general form.

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* This beautiful series of researches should be studied by the aid of Dr. Hofmann's papers, published in the following Journals :—

'Liebig's Annalen,' vol. liii., p. 1.

'Researches on the Volatile Bases,' 'Quarterly Journal of the Chemical Society,' vol. i., pp. 159–269 ; vol. ii., pp. 36, 104, 300.

'Researches regarding the Molecular Construction of the Volatile Organic Bases,' 'Phil. Trans.,' vol. cxli. (1850), p. 93.

'Researches into the Molecular Constitution of Organic Bases' (this paper is devoted to such as are not volatile, and continued in papers subsequently published), 'Phil. Trans.,' vol cxli. (1851), p. 372.

We abstract some remarks from one of Dr. Hofmann's papers* which bear strongly on this point. At a very early period, as far back as 1837, Berzelius, on the grounds of Liebig's researches, expressed the opinion that the natural alkaloids which at that period engrossed the undivided attention of chemists were peculiar ammonia compounds—conjugated compounds, in which the chemical character of ammonia, modified indeed by its conjunct, was still perceptible. This view, which was principally founded on the remarkable analogy of the ammonia salts and the salts of the alkaloids, met by no means with general approbation when first started; but it has been retained and carried out by Berzelius, and it cannot be denied that since that period, science has acquired a great number of facts which powerfully support his opinion. Organic Chemistry has been enriched by a long series of artificial bases, which is almost daily being increased. These bases are formed in a variety of processes, many of which products we see generated by the direct action of ammonia on other compounds. Numerous examples are given, and Dr. Hofmann remarks:—"From the transition of these indifferent substances into bases under the influence of reagents, giving rise in so many cases to the formation of ammonia, does it not become exceedingly probable that in this case part of the nitrogen has been reconverted into ammonia, which uniting with the remaining elements has impressed its character on the whole compounds?"

To these investigations may be referred Gerhardt's classification. Mr. G. C. Foster† says, "The reconciling of the theory of types with the theory of compound radicals, which resulted from the discovery of the compound ammonias by Wurtz and Hofmann, and the discovery of the mixed ethers (or ethers containing two distinct alcohol radicals) by Williamson, prepared the way for Gerhardt's classification of chemical substances, according to the types of double decomposition."

It must not be forgotten that in the memoir published in the 'Philosophical Transactions' already referred to, will be found the first typically written formulæ. Researches of this high character leading to such important results in the philosophy of a science could not fail to earn for their author substantial acknowledgments. The interest taken by the Royal Society was evinced by two successive grants of large sums of money during the progress, and to meet some of the expenses, of this inquiry. The Royal Society also awarded to Dr. Hofmann their Royal Medal on the completion of the investigation. In rapid succession the fortunate experimenter became a Correspondent of the Institute of France (which conferred upon him moreover the great prize, value 5,000 francs), and of nearly all the academies and learned societies of Europe and America.

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* 'On the Action of Chloride, Bromide, and Iodide of Cyanogen on Aniline,' 'Quarterly Journal of the Chemical Society,' vol. i., p. 285.

† 'British Association Report: 29th Meeting at Aberdeen, 1859,' p. 1. This report is deserving of careful study.

During the period between Dr. Hofmann's becoming Professor of Chemistry in the Royal School of Mines and his return to his native country, numerous researches were carried forward and records of them published; amongst others may be especially named his 'Memoirs on the Phosphorous Bases and the Polyammonias.'*

This is a bald outline of the treasures added by Dr. Hofmann to the rich harvest of discoveries which of late years have rewarded the exertions of chemists. With reference to their general effect on the progress of the science, we cannot avoid recognizing, as one of the most valuable amongst its acquisitions, the development of the theory of polyatomic compounds. The names of other great chemists are of course associated with the advances which have been made; and in confining our notice to the labours of Dr. Hofmann, it must not be supposed that they have been forgotten. We have been writing, not a history of modern chemistry, but a concise statement of the part which one man has taken in this fertile field of discovery.

Beyond the inquiries to which we have referred, we find Dr. Hofmann engaged in many others of a strictly practical nature.† As a juror Dr. Hofmann heartily co-operated in the three International Exhibitions, and the reports which he furnished are generally valued. It is not easy to conceive anything more complete, as it respects the state of chemistry in 1862, than the Chemical Report on the Exhibition of that year.

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* The Memoirs which have appeared since this period in the 'Philosophical Transactions' are :—

"Researches on the Action of Sulphuric Acid upon the Amides and Nitrites, together with Remarks upon the Conjugate Sulpho-Acids," June 12, 1856. In this paper Mr. George Buckton is associated with Dr. Hofmann.

"Researches on a New Class of Alcohols," June 18, 1857. Vol. cxlvii., p. 555. In this Dr. Hofmann is associated with A. Cahours.

"Researches on the Phosphorus Bases," June 18, 1857. Vol. cxlvii., p. 575.

"Contributions to the History of the Phosphorus Bases." First Memoir.

Ditto. ditto.
"Theory of Diatomic Bases—Diphosphonium Compounds." } Second Memoir.

Ditto ditto.
"Phosphammonium and Phospharsonium *et* Diarsonium and Arsammonium Compounds," June 22, 1860. Vol. cl., p. 409 *et seq.* } Third Memoir.

† Hofmann and Graham—"Report on the Alleged Adulteration of Pale Ale by Strychnine."

Hofmann, Graham, and Redwood—"Report upon 'Original Gravities.'"

Hofmann, Graham, and Miller—"Chemical Report on the Supply of Water to the Metropolis."

Hofmann and Witt—"Report on the Metropolitan Sewage Question."

The "Introduction to Modern Chemistry" which Dr. Hofmann has given us, on the eve of his departure from this country, is another choice example of the completeness of all his works. It is a clear and concise explanation of the most recent views entertained by modern chemists, and of the experimental proofs by which they are supported. It should be in the hands of every young student of the science.

Dr. Hofmann, after having repeatedly declined invitations to return to his native land, has at last yielded. The Prussian Government conceived the idea of erecting in the University of Bonn,—which is the scientific centre of the Western Provinces of the kingdom,—a Chemical Institution on a grand scale, intended, not only to supply the wants of the University, but calculated also to advance the rapid growth of the industrial interests of the surrounding provinces of Rhineland and Westphalia, which have, not inappropriately, been called the Lancashire of Germany. The invitation to organize the new institution, for which most ample funds have been provided by the Chambers, coming as it did from the university in which so many years ago he had commenced his professional career, proved irresistible to Dr. Hofmann. In 1863 he undertook an extensive journey through nearly all the European Universities in which chemistry is prominently taught, for the purpose of collecting the needful preliminary information. The data thus gathered he embodied into an elaborate plan, going into all the numerous mechanical details involved in the prosecution of modern chemistry. This plan was adopted by the Prussian Government, and the magnificent buildings, exclusively intended for the advancement of chemical knowledge, and which promise to become a model laboratory, are now rapidly approaching completion.

While things were thus moving forward in the Rhineland University, an event occurred which was to influence and deeply to modify all the plans which Dr. Hofmann had formed with regard to Bonn. At the end of 1863 the celebrated Mitscherlich died at Berlin. Early in 1864 the Senate of the University of Berlin elected Dr. Hofmann to become his successor. The Prussian Government sanctioned this election, and charged Dr. Hofmann with the organization in Berlin—as the scientific centre of the Eastern provinces—of a laboratory similar to that of Bonn, leaving him the option after the completion of the two Institutions of taking up his abode at either one or the other of these cities.

In the summer of this year, Dr. Hofmann left London for Berlin. On the 28th of April a farewell banquet was given to him by "a number of gentlemen who had worked with Dr. Hofmann at the Royal College of Chemistry," and every one, from the Comte de Paris to the youngest chemist present, expressed their sorrow at the departure of their master, and their hopes that his absence from the land of his adoption would not be a prolonged one.

This notice of one of the men foremost in advocating those new doctrines which distinguish Modern Chemistry, and which are now acquiring an ascendency throughout Europe, cannot be more appropriately concluded than by borrowing a few thoughts from the last lecture delivered at the Royal Institution by Dr. Hofmann.

The intricate formulæ of the modern chemists, and the boundless variety of the phenomena which they illustrate, were not long since like an impassable labyrinth; but Dr. Hofmann has given us a clue, and a sense of mastery and power succeeds in our minds, to the sort of despair with which we first contemplated this tedious category. By the aid of a few general principles, however, we are now able to unravel the complexities of these formulæ, to marshal the compounds which they represent, in an orderly series, to multiply their numbers at will, and in a great measure to forecast their nature ere we have called them into existence. The great movement of Modern Chemistry is "a movement as of light spreading itself over a waste of obscurity, as of a law diffusing order throughout a wilderness of confusion, and there is surely in its contemplation something of the pleasure which attends the spectacle of a beautiful daybreak, something of the grandeur belonging to a world created out of chaos."

CHRONICLES OF SCIENCE.

I. AGRICULTURE.

The whole agricultural interest of the quarter has centred in the progress of the cattle plague, to which reference is made in another page. We add to the details there given that the number of the new cases reported to the Veterinary Department of the Privy Council, which was only a few hundreds weekly in the early part of autumn, reached 2,600 in the week ending November 18th, 3,600 in the week ending November 25th, 3,800 in the week ending December 2nd, and upwards of 5,000 in the week ending December 9th.

We do not know how local fears may have exaggerated in the instances out of which these aggregates arise; but any discount which such a consideration as this might justify is more than balanced by the large number of cases in which losses by the plague are concealed, in order to escape the exercise of the stringent powers which have been vested in inspectors.

No treatment, allopathic, hydropathic, or homœopathic, has been hitherto successful. The proportion of recoveries has not been influenced by any cause which has yet been put in operation, though no doubt good nursing must help the patient through when the vital energy would otherwise be barely overcome.

In connection with the cattle disease and the London cowhouses, where it first appeared, a paper on London Milk has been read by Mr. Morton before the Society of Arts, in which he declares that, coming to the examination of the subject with the prejudices of a countryman that London cowhouses are an abomination, that Londoners are ill fed with milk, and that the right way to supply a town with milk is to bring it in from the country,—he has come round to the conclusion that London cowhouses need not be a nuisance, that London is better fed with milk than the average of south country villages, and that the right way to ensure a supply of good milk to any considerable body of people is to have it produced as near as may be to their own doors. The analyses made by Dr. Voelcker, for the purpose of this paper, prove that the milk consumed in London is very much diluted, but they also prove that water is the only diluent employed, and that all the stories about chalk and "brains" and mucilage of various kinds are fiction. The difficulty connected with a supply of milk to London from the country arises out of the extreme facility with which milk sours and becomes offensive in hot weather. The ordinary milk-can carried on an ordinary railway truck is not to be depended on for delivering its contents sweet at the end of a journey of sixty miles in summer time. And although it appears at first as if it were wiser to carry fifteen or twenty pounds of milk from the farm to the town than to carry the hundredweight of food out of which it is made as far to a cowhouse in the town, yet dealers in milk will give so much more for the townshed milk than for the country milk, that there is a great profit and advantage to all concerned in carrying the larger weight, though it be of course at a greater cost.

II. ASTRONOMY.

The President of the Astronomical Society, Warren De la Rue, F.R.S., has communicated some observations of the partial eclipse of the moon, of October 4, 1865. On the occasion of a former partial eclipse—*viz.* that of February 27th, 1858—several photographs were obtained of the moon, and he was led to suspect the existence of an anti-actinic influence extending beyond the limits assignable to the penumbra. To ascertain whether any such influence really exists was the principal object on the present occasion. Operations were, therefore, commenced some little time previous to the first contact of the penumbra; and the night at Cranford being very bright, and the atmosphere tolerably steady, photographs of the moon were obtained with an exposure of from one to three seconds, using for that purpose Steinheil's silvered glass mirror of 13 inches aperture and 10 feet local length; the action of which however was not more rapid than that of the speculum-metal mirrors (of the same dimensions and focal length), which had been hitherto chiefly used in celestial photography. After contact, it was found that an instantaneous exposure sufficed to give a faint impression of that portion of the lunar disk not obscured by the umbra, or penumbra, an exposure of a whole minute failed to bring out the portion of the lunar surface covered by the umbra, although its details were plainly perceptible in the telescope. The obscured portion of the moon was, moreover, perfectly visible without optical aid. To the naked eye, and even in the finder, the dark limb of the moon appeared to be bounded by a silvery thread of light; but this illusion disappeared under powers of 90 and 140. both in the reflector and in 4 1-8th inch Dallmeyer. The umbra towards the moon's limb had a coppery glow, while that towards the penumbra was of an ashy grey colour. The penumbra could be much better traced when the image was projected on a screen placed in the focus of the reflector than when viewed directly through the eye-piece; and probably—though this experiment was not tried—the projection of an enlarged image of the penumbra by means of the eye-piece would still further have enhanced the distinctness of view. As the penumbra gradually encroached on the disk, it was remarked that the various details of the lunar surface came out much more distinctly than when seen under the full and direct illumination of the sun; and but for the intention to devote the telescope for the time being solely to photography, some noteworthy observations could have been made respecting the configuration and appearance of lunar objects under the peculiar circumstances of an eclipse. Seventeen photographs were procured between 7h. and 11h. 5m., this interval of time commencing nearly an hour and a half previous to the first contact of the penumbra, and concluding 25 minutes after the greatest phase. At the discontinuance of the observations the night was still bright.

The photographs of February, 1858, stand in the stereoscopic relation to those of October, 1865—*i. e.* they combine in the stereoscope and produce good stereoscopic pictures of a lunar eclipse. Also, to our eyes, two pictures taken at different epochs of the late eclipse, when viewed in the stereoscope, while they necessarily show the moon as a flat disk, do yet present the shadow as raised or protruded, giving in fact the impression of a flat picture of the moon covered by a glass shade. This impression, however, is not conveyed to all observers.

Below we give a brief account of the most noteworthy photographs which Mr. De la Rue succeeded in taking during the continuance of the eclipse.

Picture No. 5, taken at 8h. 19m. 7s. (exposure one second), shows no appearance of the penumbra. The first contact of the real penumbra occurred, according to the 'Nautical Almanack,' at 8h. 25m. 54s.; and he had anticipated the possibility of being able to trace some anti-actinic effects beyond its limits; but the expectation was not realized.

Picture No. 6, 8h. 29m. (exposure two seconds), penumbra just traceable; the first contact of the moon with the penumbra occurred about three minutes before the epoch of this picture.

Picture No. 9, 9h. 21m. 29s. (exposure two seconds). The elliptical projection of the cone of the penumbra well marked, commencing close to the south pole, and traceable over Malapert, Cahous, Short, Moretus, Gruemberger, over the centre of Clavius, skirting Longomontanus, over Hainzel, covering Vitello, on the border of Mare Humorum, over Vieta and Byrgius, and passing off at the 20th parallel of south latitude on the western limb. No part of the umbra was then on the moon's disk, and the whole contour of the moon is visible on the photograph.

Picture No. 10, 9h. 38m. 58s., about 46 seconds after the first contact of the umbra (exposure three seconds), the moon's surface is invisible in the photograph to a small extent beyond the boundary of the umbra, which gradually softened off into the penumbra. The truncation of the cones of the umbra and penumbra is seen in perspective as well-marked ellipses.

Picture No. 11, 10h. 41m. 17s. (exposure three seconds), a little later than the middle of the eclipse, which occurred 1m. 42s. earlier. The obscuration of the umbra and penumbra extends in a curved line, commencing in their visible effects on the photograph at the parallel of 15° south latitude on the western limb, passing over Langrenus, Goelenius, Guttemburg, Capella, Theophilus, Kant, Dollond, Albategnius, Ptolemæus, Parry, Bonpland, Euclides, above Flamsteed, and passing over the southern limb of Grimaldi, above the parallel of 10° of south latitude.

Picture No. 16, 12h. 54m. 12s., was exposed exactly one minute, ending at the above-named time; the unobscured portion of the moon was completely solarized, and the details in consequence lost; yet not the slightest trace of any part of the lunar disk was depicted within the limits of the umbra. The next picture was instantaneous, the exposure certainly being less than a quarter of a second, yet the whole of the unobscured surface is clearly though faintly depicted.

The Astronomer Royal has published a long paper on the value of the moon's semi-diameter as obtained by the investigations of Hugh Breen, Esq., from occultations observed at Cambridge and Greenwich.

A proposal having been made by Mr. Breen to extend the reduction of the occultations observed at Greenwich, it was suggested by Professor Airy that the occultations, in their reduced form, as exhibited in the 'Greenwich Observations,' might be used for the determination of the semi-diameter of the unilluminated moon. Mr. Breen accepted this suggestion, and the Admiralty sanctioned the undertaking and supplied the necessary funds. Mr. Breen determined on applying his computations to the occultations observed at the Cambridge Observatory during the Astronomer Royal's presidency over that Institution, ending with 1835, and to those observed at the Greenwich Observatory from 1836 to 1860.

Mr. Breen originally included in his computations the occultations of every class. But viewing the causes of inaccuracy of various kinds attending the occultations of planets—the uncertainty of the planet's place for the day, the uncertainty of the planet's semi-diameter, the difficulty of correction for phase and the general rudeness of the observation—it was thought best to strike out the planets and to confine the investigations to stars.

The results were divided into four classes:—

I. Disappearances of Stars at the Dark Limb; II. Disappearances at the Bright Limb; III. Reappearances at the Dark Limb; IV. Reappearances at the Bright Limb. The following are the means of results for Occultation-correction for the Final Telescopic Semi-diameter in the four classes:—

I. Disappearances of Stars at the Dark Limb:
Mean from 130 occultations . . . . . $-1''{\cdot}98$
No observations excluded.

II. Disappearances of Stars at the Bright Limb:
Mean from 51 occultations . . . . . $-0''{\cdot}65$
Four observations excluded.

III. Reappearances of Stars at the Dark Limb:
Mean from 64 occultations . . . . . $-2''{\cdot}32$
Ten observations excluded.

IV. Reappearances of Stars at the Bright Limb:
Mean from 50 occultations . . . . . $+1''{\cdot}38$
Eleven observations excluded.

From the nature of the observations, the first and third of these means are very far superior to the second and fourth, and the first is greatly preferable to the third. We cannot be sensibly in error in saying that the moon's Occultation Semi-diameter is less than the moon's Telescopic Semi-diameter by $2''{\cdot}0$.

Mr. De la Rue, from his photographs taken during the eclipse of 1860, obtained the following corrections to the Telescopic Semi-diameter:—

By the differences between observed and tabular distances of centres, deduced from the measurements of peripheries, and of the measures of cusps of *all* the photographs. . . . . . . $-2''{\cdot}1$

By the times of first and last contact, deduced from the measurements of the distances of the peripheries in the photographs taken near these epochs . . . . $-2''{\cdot}2$

By the times of first and last contact, deduced from the measurements of the distances of the peripheries *and of the cusps* in the photographs taken near these epochs . . . . $-1''{\cdot}0$

Mr. T. Fletcher, of the Tarnbank Observatory, has drawn the attention of those astronomers who are in possession of large telescopes, to the present condition of that most remarkable star ζ *Herculis.* With his large refractor of 9½ inches aperture and a power of 1,000 it is absolutely single. A few years ago, he had no difficulty in measuring it both in position and distance with a telescope of 4 in. aperture only. As the companion star is undoubtedly close upon its perihelion, the earliest possible observation of its reappearance will be of great value in the determination of its orbital element. Mr. Dawes states that *last year* he found the star quite single.

III. BOTANY AND VEGETABLE PHYSIOLOGY.

Mr. Gulliver continues his researches among raphides, and brings out some curious results. In Vitaceæ he finds them universally present, while in Lindley's Berberal alliance, the allied orders placed round Vitaceæ are apparently universally devoid of them. Thus also *Leea*, placed by Lindley under Vitaceæ, contrary to the opinion of Von Martius and others, contains raphides like other Vitaceæ, which order appears to be as truly a raphis-bearing one as Balsaminaceæ, Onagraceæ, &c., are; and thus the importance of these minute organs becomes apparent. In a later contribution to the subject, he has continued his remarks, and finds that in every genus of Vitaceæ examined there were traces of raphides, except in Bersama and Natalia, in which raphides are replaced by crystal prisms having four equal faces, their ends sloping off, either from angle to angle or from face to face. The same interchange occurs also in Roxburghiaceæ (Dictyogeneæ). The Araliceæ abound in sphæraphides but are destitute of raphides, while Pandanaceæ, like the rest of Lindley's Aral alliance, abound in raphides.

In the 'Comptes Rendus' M. Boussingault describes some experiments upon the functions of the leaves of plants, the results of which appear to be:—1st. That leaves exposed to the sunlight do not decompose pure carbonic acid, or if they do, they do it with extreme slowness; 2nd. Under the same circumstances in a mixture of carbonic acid and atmospheric air they decompose the acid rapidly. The atmospheric air appears to have no active part in this phenomenon. 3rd. Leaves exposed to the sun rapidly decompose carbonic acid, when mixed either with nitrogen or with hydrogen. Although the decomposition of the acid is a phenomenon of dissociation, M. Boussingault traces a pretty close analogy between it and the slow combustion of phosphorus.

Mr. Roland Trimen gives in the 'Linnæan Journal' an account of the structure of Bonatea speciosa, a Cape orchid, from which it appears to be eminently adapted to insect fertilization, so that probably the length of the nectary and the amount of nectar it contains are so contrived as to necessitate the hungry visitant's probing even its head into the rostellum cup in order to obtain the sweet fluid, in which case the attachment of one or both of the viscid disks to some portion of the underside of the head or proboscis seems inevitable. The most remarkable point in the structure of this orchid is undoubtedly the erect process of the labellum. Its sole use and object are unmistakable, and its abrupt prominence seems so foreign to the general character of the labellum and petals, that it would be difficult to find, even in the orchidean order, a more striking instance of special modification. With the exception of this local development of the labellum, no part of the perianth appears to conduce directly to the fertilization of the flower, but the extraordinary modification of the columnar organs effects what is required. The lateral petals, which in so many South African Ophreæ are of the utmost importance, are of no direct service in Bonatea. The prominent and magnificent group of cohering sepals and petals appears to serve the purposes of protecting and supporting the stigmatic processes, and of affording a convenient landing place for insects. Possibly, too, its singular form may give it some attractive influence. It may be added that Mr. Darwin especially directed Mr. Trimen's attention to this species, and requested him to investigate its structure, but Mr. Trimen's observations have hitherto only been made upon cultivated specimens, and the evidence is, therefore, not quite perfect.

Dimorphism, to which attention has so often been directed of late, has been found by Dr. Dickie to occur in Eriophorum angustifolium. In the neighbourhood of Aberdeen, he observed in May that there were obviously two forms of flower, one with slender spikes, having only stigmas visible; the other, with shorter and blunter spikes, with very prominent anthers and short stigmas. In the first, on dissection it was found that in each flower there were three stamens in a rudimentary condition, which remained so till the end of the month, when there was still no pollen in them; while in the second form the anthers were large and prominent, yielding copious pollen; the stigmas were shorter than the stamens, but were apparently well formed, although shrivelled; they had evidently exercised their special function, and this at the time when the stigmas of the other form were still fresh and their tissues full of fluid. In both forms the seeds apparently reached their full ripeness, and on dissection there was no apparent difference, and about forty seeds of each form were sown under precisely the same conditions. Almost every seed of them from plants with large anthers and short stigmas sprang up and continued to grow; while not more than five or six of the seeds from the other form showed any sign of life. The experiment was repeated with the same result. Dr. Dickie adds that having examined some duplicates of this species from the shores of Davis's Straits, he finds that they also have the two forms.

The Imperial Society of Natural Sciences at Cherbourg have proposed a prize question for the year 1868: "Sea-wrack, considered with reference to Agriculture and Industry." The prize will be a Gold Medal of the value of 500 francs.

M. Lestiboudois continues his investigations upon the fluids of plants, in the 'Comptes Rendus,' his latest being with reference to the existence of solid and liquid matters in the *tracheæ*, which are usually supposed to be reservoirs of air. These liquids, however, being perfectly clear, may be ordinarily invisible; moreover, when separated from the plant, air would readily find its way into them. He maintains that there is no proof that tracheæ are exclusively tubes for the conduction of gases. In their youngest condition the trachean vessels are found to be full of fluid, like the other elementary organs, though this fluid appears to be lost at a more advanced stage. He believes, however, that they are still traversed by denser liquids, and his observations go to prove that these liquids may become so much thickened as ultimately to fill up the cavity and obstruct the circulation. Thus, in the stem of the Rotang he found that the great vessel occupying the centre of most of the bundles was filled with a solid white material, with cylindrical masses sometimes continued, sometimes broken up, and which broke up into granules when immersed in water, the granules having a very active movement, although the vascular tissue had long been dried up. In a vine stem also, cut into short pieces, a transparent matter of the consistence of gum was found to exude in abundance from the cut surfaces in a very short time. Smaller sections being cut, he found the next day that in the mean time gummy filaments had protruded from the large vessels, from which he infers that the tracheæ, even in old plants, contain matters of considerable density as well as the aëriform substances which are usually considered to be their sole contents.

M. Caspary describes an organ in plants which he terms the protective sheath, consisting of a layer of very closely approximated cells placed in a single series in thickness, which protects the vascular system of the stem, roots, and leaves. In some cases, however (as in Berberis), this layer is ruptured during its growth, and consequently does not serve to protect the organs which it envelopes. He observes certain folds upon the cell walls of the protective sheath of Ficaria ranunculoides, &c., which at first appeared to be pores, but when the cells of the protective sheath become thickened these folds gradually disappear, a change which he attributes to the elongation of the walls of the cells. This protective sheath has been regarded by M. Karsten as a lignified residue of the layer of cambium, which has produced the other parts of the stem; but M. Caspary controverts this, and also maintains that the entire terminal bud is formed of cambium, and already contains the mother-cells of all other kinds of tissue which will subsequently form the various parts of the stem, against the opinion which derives all the parts of the stem from a single layer of cambium existing in the terminal bud. (For an abstract of his paper, see 'Annals Nat. Hist.')

In the 'Comptes Rendus' M. Fournier makes some observations upon the fruit of the Cruciferæ, which tend to throw additional light upon its construction, and show that it is to be regarded as formed of two carpels alternate with the placentas, and of two intervalvar placentæ, from which the septum issues on each side, and by a double origin.

M. Naudin, "the most distinguished experimental fertilizer on the continent," has sent to the 'Natural History Review' a paper in which, after remarking upon the well-and-long-known facts of the variability of cultivated plants, and their tendency to give rise to secondary or derivative forms, he expresses his opinion that this phenomenon is not limited to cultivated species, but considers it infinitely more probable that it has taken place in nature on a much wider scale than in the narrow domain of our industry; and that the best characterized species are so many secondary forms, relatively to some more ancient type which actually comprised them all, as they themselves comprise all the varieties to which they give birth under our eyes, when we submit them to cultivation. He then dwells upon the fact that, variable as are vegetable forms, they have a strong analogy with each other, which is explicable upon the system of common origin and of the evolution of forms. There are seven or eight hundred kinds of Solanum disseminated over an immense extent of country in the Old and New Worlds; all are specifically distinct, but all resemble each other in a certain sum of common characters, and the view that this relationship is of derivative origin, he says he expressed in 1852, when he said (Revue Horticole):—"We do not believe that nature proceeded in the formation of species, in any other manner than we ourselves proceed to form varieties." He now states his belief in the unity of origin and in the derivation of living beings from the same branch, and by consequence in a single focus of creation, whence the stocks of these great branches have been elaborated from a common nucleus: and that the multiplied forms, during the process of multiplication in the course of ages, have always followed divergent paths, and that in consequence it is contrary to nature to suppose that species can be changed the one into the other, or that two species can be melted into one by hybridization. M. Naudin's opinions will be received with respect, but inasmuch as he merely indicates his belief in derivation of species without assigning any physical cause, they can only be regarded as confirmatory of the Darwinian theory, and not in any manner as independently originating it.

A remarkable circumstance in the history of Lichens has been brought before the Natural History Society of Dublin by Admiral Jones. It is the discovery of spiral vessels in the thalles of Evernia prunastri. Dr. Moore saw them and expressed his belief that there was no doubt of the fact. Spiral vessels had been found in certain fungi, and analogy would lead one to suppose they might possibly be met with in lichens. Mr. Archer considered the vessels in question as neither annular nor scalariform, but truly spiral, and where through the brown cellular mass he had been able to trace the ends of the fibres, he found that they gradually tapered, and in one instance one had been broken off by pressure and the fibre uncoiled. There was a peculiarity about these vascular bundles, *viz.* that certain of them, running up and down parallel with the other vessels of the bundle, upon meeting did not overlap, but suddenly diverged at right angles from the rest, and were prolonged in a direction vertical to them, the whole bundle having a T-like form.

Botanical Science has sustained lately two great losses in the deaths of Sir W. J. Hooker and Dr. Lindley. The former, as Director of Kew Gardens, has long been known as a scientific botanist of eminence, and the father of a greater botanist, Dr. J. D. Hooker, who succeeds him. Dr. Lindley long filled the chair of Botany at University College, and but recently retired from that position, to be succeeded by Mr. Oliver. Dr. Lindley's works upon his favourite science are justly celebrated—his 'Vegetable Kingdom' being the most comprehensive condensed account of the subject in our language. Few English botanists equalled Dr. Lindley in the acuteness of his scientific views and the perspicuity of his writings.

IV. CHEMISTRY.

(*Including the Proceedings of the Chemical Society.*)

There is but little of general and popular interest to chronicle this quarter in the progress of a science which nevertheless goes on developing itself at a rate unparalleled in the history of any other branch of knowledge. A Registrar-General of Chemistry might present us with a list of the new compounds born perhaps daily in the laboratories of the numerous chemists who are devoting themselves to the science; but our limits will not allow us to assume the functions of such an official, and we must content ourselves with presenting our readers with a short account of those discoveries which have a general and practical interest rather than those, however valuable, which have a purely scientific bearing.

Following the usual order, and adopting the now almost discarded distinction between organic and inorganic chemistry, we may first refer to the discoveries in the latter branch. And first among these we must mention the announcement made by Dr. A. W. Hofmann, at the meeting of the British Association, of the discovery, by Lossen, of a series of bodies intermediate between nitric acid and ammonia. In the reaction of nitric acid upon certain metals it is well known that ammonia is formed; Lossen, however, has shown that the ammonia is only the final product of the reaction, and that a whole series of intermediate bodies existed between the nitric acid and the last product of its reduction. One of these bodies Lossen has succeeded in isolating, and has found it to have the formula H_3NO. It may, therefore, be regarded as protoxide of ammonia, or, more scientifically, as ammonia in which one atom of hydrogen is displaced by the residue of water HO, *hydroxyl*, as it has been called. Viewed in the latter light, the new body may be termed *hydroxylamine*. Like ammonia it combines with acids, and yields a series of magnificent and easily crystallizable salts. As Dr. Hofmann remarked, it is interesting to see the simplest (?) of reactions familiar to every chemist still yielding a harvest of such splendid results.

Since the above was written we have seen* an abstract of the memoir on the subject presented to the Berlin Academy by Dr. Lossen. In this we find the method of preparing hydrochlorate of hydroxylamine. Five parts of nitric ether, and 12 parts of tin are added to 50 parts of hydrochloric acid, sp. gr. 1·124. The mixture soon becomes hot, and hydrogen is evolved. When the reaction has terminated, the tin is removed from the solution by means of sulphuretted hydrogen, and the filtered liquor is evaporated. Sal-ammoniac first crystallizes out, the hydrochlorate of hydroxylamine being extremely soluble in water. The two bodies may be completely separated by dissolving both in absolute alcohol, and precipitating the sal-ammoniac with chloride of platinum, with which the hydrochlorate of hydroxylamine does not combine.

We may here mention some experiments of Dr. Wetherill on ammonium amalgam,† which tend to disprove the existence of the compound metal NH_4. Referring the reader to the paper indicated below, we need only state that the author's experiments have led him to the conclusion that the so-called amalgam is not an alloy of mercury and ammonium, but merely a mass of mercury distended by bubbles of ammoniacal gas.

A very interesting experiment devised by Kraut is described in the 'Annalen des Chemie und Pharmacie' for October, and will be found in the 'Chemical News.'‡ The author hangs a platinum spiral in an open wide-mouthed flask containing so much strong ammonia, that the liquid nearly reaches to the end of the spiral. Having made the spiral and the ammonia hot, he passes a stream of oxygen through the liquid. The active decomposition of the ammonia, which now takes place, soon brings the platinum spiral to a bright red heat, and the mixture of gases is exploded. The explosion reduces the temperature of the spiral for a moment, but the action proceeding, the wire is again made red hot, and another explosion is produced; and so on as long as the experimenter wishes. By introducing a very rapid stream of oxygen near the level of the ammonia, and close to the spiral, a continuous combustion may be kept up, producing the long-drawn sound which is heard when a jet of hydrogen is burned in a vessel of oxygen.

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* 'Chem. Central Blatt,' No. 61, 1865, p. 970.

† 'Chemical News,' vol. xii., p. 207.

‡ Vol. xii., p. 231.

In the first stage of this reaction before the ammonia is made hot, Kraut shows that the ammoniacal vapours are oxidized, and nitrous acid produced, which combines with undecomposed ammonia to form the nitrite.

Very recently* Wöhler has stated that nitrous acid is also formed when ammonia is oxidized by means of permanganate of potash. The decolorized solution filtered from the precipitated hydrated peroxide of manganese and evaporated, yields a mixture of carbonate and nitrite of potash, the latter shown by the evolution of red vapours on the addition of an acid.

Mitscherlich and Diacon have discovered simultaneously a means of detecting chlorine, bromine, and iodine in the presence of each other, by the aid of the spectroscope. Their observations will be found described in a subsequent place; but we may state here that the first-named author announces that his experiments have led him to the conclusion that nearly all the metalloids are compound bodies. At present, however, he brings no observations in support of the statement.

In the department of purely organic chemistry, the synthetical researches of Messrs. Frankland and Duppa on Ethers, deserve the first mention. In their last communication to the Royal Society, these gentlemen described the action of sodium and iodide of ethyl on acetic ether, and explained the formation of ethylic diacetone carbonate, and ethylic acetone carbonate, colourless transparent fragrant liquids, which treated with caustic baryta yield—the first, diethylated acetone; the second, ethylated acetone. The former of these has a powerful odour of camphor; the latter possesses a powerful and agreeable smell, in which the odour of camphor is slightly perceptible. We look on these bodies as objects of great interest, and it is perhaps among such that a liquid will one day be discovered possessing all the advantages, but free from the dangers of chloroform. In the same paper the authors describe the action of sodium and iodide of methyl upon acetic ether, by which a series of bodies completely homologous with the above is obtained.

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* 'Annalen des Chemie und Pharmacie,' November, 1865, p. 256.

M. Campisi has announced* the formation of a new organo-metallic body, a compound of mercury with benzyl $H\ (\text{Ꞓ}_7\,H_7)_2$. The author has not yet published the process by which it is prepared.

It must suffice to mention the discovery by MM. Friedel and Crafts of a new alcohol, in which a part of the carbon is replaced by silicium,† a discovery which adds another illustration of the resemblances in the chemical behaviour of carbon and silicium.

Among the few practical improvements in manufacturing chemistry published we find a ready method of converting gallic into pyrogallic acid. By the usual process, that of sublimation, it is well known that only from 30 to 40 per cent. of the gallic becomes changed into pyrogallic acid, the remainder being lost in the empyreumatic matters generated. MM. V. De Luynes and Esperandieu therefore heat the gallic acid with water under pressure up to 210° C. for about an hour-and-a-half, and so obtain a solution containing exactly the theoretical amount of pyro-acid, which ought to be yielded by the amount of gallic acid employed.

M. Pelouze has published a method of making a glass which is said to exceed in beauty Venetian aventurine. He fuses together 250 parts of sand, 100 parts of carbonate of soda, 50 parts of carbonate of lime, and 40 parts of bichromate of potash. The resulting glass contains from 6 to 7 per cent. of chromium, about one-half of which is combined with the glass, communicating a magnificent greenish yellow colour, while the other is distributed through the mass in the form of extremely brilliant crystalline scales. The new glass, it should be said, is exceedingly hard.

PROCEEDINGS OF THE CHEMICAL SOCIETY.

At the opening of the meeting of the current season, Professor Church gave an account of his chemical researches on some Cornish minerals. Among these he found three which had not been previously described:—1, a hydrated phosphate of cerium; 2, a hydrated phosphate of calcium and aluminium; and 3, a hydrated arseniate of copper and lead. The last of these the author proposes to call Bayldonite. For the first the name Churchite has been proposed by Mr. Greville Williams, who by optical tests discovered the presence of didymium in the same mineral.

At the same meeting a paper "On Caprylic and Oenanthylic Alcohols," by Mr. E. T. Chapman, and one "On the Absorption of Vapours by Charcoal," by Mr. Hunter, were read. The experiments of the latter author confirm those of Dr. Stenhouse, who found that the denser forms of vegetable charcoal possessed the greatest absorptive power. Mr. Hunter stated that the charcoal prepared from cocoa-nut shell condensed the largest amount of the various vapours he experimented with. These included the vapours of water, bisulphide of carbon, common alcohol, methylic and amylic alcohols, benzol, ether, and chloroform, and of these the vapour of methylic alcohol was most freely absorbed. It was remarked that the absorption of vapours by charcoal is always terminated in a much shorter time than in the case of permanent gases.

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* 'Comptes Rendus,' Nov. 13, 1865.

† 'Comptes Rendus,' Nov. 6, 1865.

At the next meeting (Nov. 16), a paper "On Nitro-compounds, with remarks on Isomerism," by Dr. Mills, was read. The paper gave an account of the author's examination of the *alpha* and *beta* varieties of nitrobenzoic acid, with especial reference to the action of hydriodic acid upon them, the difference in their behaviour to this agent being considered to indicate a difference between the nitryl radicals they contain. The author also pointed out a difference in the behaviours of naturally formed benzoic acid, that obtained from gum-benzoin, and the acid procured artificially, the former being nitrated with considerable difficulty, the latter with comparative ease. A mononitrated compound is ordinarily obtained with the natural acid, while the artificial yields a dinitro-compound. But on raising the energy of the attack by employing a mixture of nitric and sulphuric acids, the author obtained with ordinary benzoic acid a dinitro-compound, possessing characters nearly identical with those of the product formed by the action of nitric acid on toluol. In his remarks on isomerism, Dr. Mills controverted the view that isomeric substances are produced by variations in the position of some radical or radicals in the molecule, and expressed an opinion that the energy of the chemical reaction at the moment of the transfer of the nitryl radical conferred upon it specific functions, and thus accounted for the differences observed in the isomers.

V. ENTOMOLOGY.

(*Including the Proceedings of the Entomological Society.*)

The attention of the Entomological Society was, at its October meeting, directed by Dr. Wallace, of Colchester, to the cultivation of the Ailanthus silk-worm (*Bombyx cynthia*), and to the probability of its becoming a lucrative occupation in this country. *Ailanthus glandulosus*, the food-plant of the insect, is a tree of remarkably quick growth even on the poorest soil, and the insects require no protection whatever, except from the birds. This year, from 18,000 eggs, he had obtained 5,000 cocoons. He had not yet attempted to wind the silk, but if this could be readily effected, he could see no difficulty to its successful cultivation, as all the necessary operations could be performed by children. "Ailantine" silk is now being introduced largely by the French merchants direct from China, notwithstanding that its culture is rapidly advancing in France.

Among the rich collections made by Mr. Wallace in the Malayan archipelago, the Buprestidæ, one of the most gorgeously coloured families of beetles, were not the least important. Mr. Wallace's set having gone to Paris, has been worked out and described by M. Henri Deyrolle in a beautifully illustrated volume. The number of species in the collection amounted to 355. Some years ago they were considered a numerous family, "200 species being known." By the way, we may mention that Australia has furnished, it is calculated, about 600 species to our cabinets, nearly all differing generically from those of the Malayan region.

To the list of insects serving as food for man we must now add the "Kungo," mentioned by Dr. Livingstone and his brother in their new work on the Zambesi. The kungo is a "minute midge" filling the air in countless millions, and "looking like smoke rising from miles of burning grass." These flies are gathered at night by the natives, who boil them into cakes, "about an inch thick and as large as the blue bonnet of a Scotch ploughman;" they "tasted not unlike caviare, or salted locusts."

The Rev. G. T. Browne, who has recently published a very interesting work on the ice-caves of Switzerland, lately sent to Mr. McLachlan, who brought them before the Entomological Society, some insects which he had found in one of those caves. Mr. Browne says:—"There was no communication with the outer air. These flies were found at a very considerable depth in the earth, down a rock-fissure, a good hundred feet below our point of entrance, which was in itself low down in a face of rock. At the bottom of this we came to a chamber, one corner of which was shut up by a curtain of ice—hermetically sealed up. We hewed a hole through it—all was utterly dark—and found only ice within. . . . The ice-roof of the ice-trough was thickly studded with these flies, standing still, but running swiftly when disturbed. I caught two, lying flat on my back and lowered by a rope. The other two were found on my dress and beard when I was dragged up again." These were caddis-flies, a species of *Stenophylax* (Trichoptera). One was a large *Paniscus* (Ichneumonidæ), apparently the only one found. It was suggested that the caddis-flies, or rather their larvæ, might have worked their way up from some underground stream, of which there were indications, but this idea will not explain the presence of the ichneumon-fly.

The new part of the Linnean Society's Transactions contains a paper by Mr. Bates, on the Phasmidæ, a most grotesque family of Orthoptera, some of them twelve inches long, and imitating sticks, patches of lichen, and living and dead leaves. Respecting the excessive variability of this family Mr. Bates says, "The difficulty which we find in defining generic groups in the family is explicable on the grounds that when there is much of this adaptive modification, all the corporeal parts concerned must have become to a high degree variable." The division of the family according to the absence of wings, or their presence in one or both sexes, appears to be highly artificial. There are now 540 species described.

Entomological Society.

At the September meeting, Mr. McLachlan exhibited three insects new to Britain—*Sialis fuliginosa*, Pictet (Neuroptera), *Stenophylax infumatus*, McLach, and *Rhyacophila ferruginea*, Hagen? (both Trichoptera). Prof. Westwood gave the Society an account of the Exhibition of Economic Entomology which was opened in Paris on the 15th of August last. Among the more interesting subjects were a great variety of bee-hives of novel construction, some of which could be sold for 1 fr. 25 c., and a large collection of silks contributed by M. Guerin-Méneville. Mr. Stevens exhibited a collection of Coleoptera from Damara-land made by Mr. Andersson.

October.—Some insects taken by the Rev. G. F. Browne, in an ice-cave in Switzerland, were exhibited by Mr. McLachlan. Dr. Wallace exhibited the various stages and entered into copious explanations respecting the Ailanthus silk-worm (Bombyx cynthia), its life-history and culture. Mr. Scudder (Secretary of the Boston (U.S.) Natural History Society) exhibited a gigantic fossil species of *Ephemera* from the Devonian Rocks of New Brunswick. He also gave a short account of Mr. Truvelot's attempts to cultivate at Philadelphia the *Bombyx Polyphemus*, another silk-producing moth. Mr. S. S. Saunders (Consul-General at the Ionian Islands) exhibited numerous specimens in spirits of the Strepsipterous genera *Xenos* and *Hylecthrus* in all their stages. A continuation of Mr. Wilson's paper on the South Australian Buprestidæ was read. A paper was also read by Mr. McLachlan on "New, or little known, Genera and Species of Trichoptera from Asia, Australia, New Zealand, and the Malayan Archipelago."

November.—A new moth taken at Manchester was exhibited by Mr. Bond; it has been named *Acidalia mancuniata* (!) by Dr. Knaggs. Some remarkable photographs of various minute parasites by Dr. Maddox were also exhibited. The following Coleoptera new to Britain were exhibited:—*Myrmedonia plicata*, Er., taken at Bournemouth, *Ægialia rufa*, Fab., *Lithocharis castanea*, Grav., and *Monotoma 4-foveolata*, Aubé. The papers read were: by the President, "On *Calamobius* and *Hippopsis*;" by the Rev. Douglas Timins, "On the Localities of European Lepidoptera;" by Captain J. Mitchell, "Remarks on Captain Hutton's paper on the Silk-worm;" by Mr. G. J. Bowles, "On the Occurrence of *Pieris Rapæ* in Canada;" by Mr. W. C. Hewitson, "On a variety of *Chrysophanus virgaureæ*, from Zermatt;" and by the same author, "Descriptions of New Hesperidæ;" by Mr. J. S. Baly, "New Genera and Species of Gallerucidæ;" and by Mr. D. Sharp, "A Monograph of the British Species of *Agathidium*." This paper contains descriptions of three new species.

VI. GEOGRAPHY.

(*Including the Proceedings of the Royal Geographical Society.*)

THE geographical intelligence since our last chronicle has been small in amount. An account of Mr. Baker's discoveries will be found in a paper read before the Geographical Society. It is strange that each of the new discoveries tends to confirm the general accuracy of the old Arabian geographer of the Middle Ages, who made the Nile rise from vast lakes in the centre of Africa. Above 500 sketches in oils and water-colours by Mr. Baines, whose book we noticed before, bring before us vividly the peculiarities of African scenery, especially the part about the Victoria Falls of the Zambesi. The latter are remarkable, inasmuch as the river disappears through a cleft from which it emerges to descend again. The spray ascends to a height of 1,200 feet, and by its subsequent fall it waters the country round for some distance.

The work of Mr. Palgrave on Central Arabia is not the mere narrative of an acute and accurate traveller, it is the experience of a man whose whole heart was in his work, who had had an excellent training, who had read all that was known about the land he visited, and was thoroughly and perfectly acquainted with the language and the religion of the country he visited. Even without the knowledge acquired by traversing a land where still the Arabic of the Koran, a grammatical and nervous language, not the weak colloquial dialect of Egypt and Syria, is spoken, the dissertations on many points of the Mahommedan religion would have become standard references. The doctrine and practices of the Wahabees throw much light on the Koran and on the position that the Mahommedan religion may be expected to hold: a subject of much importance at a time when the African missions are being discussed by bodies of men from a purely external point of view, utterly unconnected with religion.

Captain Wilson, R.E., has succeeded in obtaining the true level of the Dead Sea. Previous observers had made it 710 feet above, 710 feet below, on a level with, and at all kinds of depths below the Mediterranean. Captain Wilson, from the work of two independent observers with separate instruments, assigns 1,292 feet as the depression on the 12th of March, 1865, a line of drift wood marking 2·5 feet above this as the level at some period of the year, and the testimony of Europeans and Bedouins unite in testifying that the sea sinks at least six feet in the summer. The greatest depression therefore would be 1,298 feet below the Mediterranean, and when the sea is highest the difference would only be 1,289·5 feet.

The success of this preparatory expedition to Palestine has led to the formation of a Society which represents opinions of all kinds on religious matters, and a great variety of speculation on scientific points, for the purpose of extending this survey and carrying out to a far greater extent the systematic exploration of many points of interest in the Holy Land. All the natural sciences are to receive due attention, and archæology is to be assisted, as it has never been previously, by well-arranged and systematic excavations Certainly in the present day it would be well that we should do somewhat towards illustrating the course of Jewish history, by an appeal to Jewish antiquities and topography, and by a thorough sifting of the geological, zoological, and botanical peculiarities of the Holy Land. What has already been done in Assyria and Egypt will in more than one way be advantageous for this work. Experience in the great work of exploration has been gained, and that from the very nations who most of all influenced the politics and the art of the Jews. We now see that the politics of the Israelites were influenced at one time by Egypt, at another time by Assyria or Babylonia. If therefore we find at Nineveh and Thebes undoubted traces of Jewish doings, how much more light may we not expect to have thrown upon explorations in Palestine, by our previous knowledge of Egyptian and Assyrian inscriptions, antiquities, and architecture?

As a kind of precursor to this more full and systematic research, Mr. Tristram has published a work which shows the amount of light that one man in a short period can throw upon a subject touched upon, indeed, by hundreds in all ages, but never scientifically exhausted. Mr. Tristram spent about eight months in various parts of the country, and was assisted by a young botanist, a zoologist, one or two sketchers, and a photographer, so that much of his information has a freshness not often observable in travellers over a well-known region. Mr. Tristram spent a considerable time in the neighbourhood of the Dead Sea. He nearly exhausts this subject. Contrary to our usual notion of this lake Mr. Tristram describes the neighbourhood as very thickly populated both by beasts and birds of great variety; the sea itself, however, is "dead," inasmuch as it contains not a living thing, fish or mollusk, and even those living in the salt pools near the shore would not survive when placed in the water of the sea. The geological peculiarities of the valley do not escape this traveller.

He would throw the volcanic action back far beyond the time of the destruction of the cities of the Plain, of the cause of this latter commotion he finds no explanation.

The Russians and Americans are pushing forward the telegraph from California across Behring's Straits to the mouth of the Amoor. It is possible that the quickest route of communication with the Western continent may be through Siberia.

In Switzerland the Aiguille Verte and the Matterhorn have both been surmounted by Mr. Whymper, the Gabelhorn by Mr. Moore, and other untrodden parts by various members of the Alpine Club, which has also done good service in assisting and bringing forward Mr. Ball's 'Guides,' with descriptions of each col and pass from the actual observation of its various members.

Besides the death so much to be lamented of climbers of this Club, we have to record the loss of Mr. Rae, a companion of Dr. Livingstone; Dr. Daniel also, an African traveller, and a medical and botanical writer.

Since 1849 nothing has been heard of the unfortunate Australian traveller Leichhardt, and his fate is somewhat doubtful. One tribe of aborigines industriously promulgated an account of his death. The locality where this is supposed to have taken place has long since been assigned to squatters, but no remains of men or cattle have ever been discovered. It is therefore thought to be possible that some members of the expedition might have been made prisoners by the natives, who, to prevent discovery, spread this report of their death. Once captured, there was but slight hope of ever escaping again, and therefore it is conjectured that some of the party might still be living in servitude. Several persons, travellers or escaped convicts, have lived amongst these tribes for a greater period than that which has elapsed since 1849; consequently the ladies of the colony of Victoria have fitted out an expedition to make a search for the remains of this unfortunate party. They applied to the female crowned heads of Europe to assist them in this romantic if not very hopeful search; the Government of Queensland have subscribed 1,000*l.* towards this object, and the other Governments of Australia have given smaller sums. If the direct object of the expedition fail, we cannot but hope that it may add somewhat to our scanty knowledge of the interior of the continent.

PROCEEDINGS OF THE ROYAL GEOGRAPHICAL SOCIETY.

At the last meeting of the Society before the close of the session of 1864–65, a paper was read, describing Lieutenant-Colonel Lewis Pelly's visit to the Wahabee capital of Central Arabia. This paper has especial interest, since the accounts of Mr. Giffard Palgrave first excited curiosity about this country. The visit of Colonel Pelly comes to supplement the jottings that the disguise of a Syriac physician alone permitted to Mr. Palgrave; in fact, one of the reasons assigned for the journey was that direct observations had not been made, and consequently the position of the cities in the interior had not been accurately determined. Official duty conveniently coincided with the desire of geographical information, and accordingly with two officers of the Government civil establishment on the Persian Gulf, Dr. Colville and Lieutenant Dawes, Colonel Pelly started for the interior on the 18th of February in last year. From Kowait, in the north-western corner of the Gulf, they travelled on camels over the desert in a direction S.S.W., journeying from a little before daybreak to sunset, when their tents were pitched with the door towards the north star, in order to enable them to make their astronomical observations during the night, when their Arab attendants were asleep. On this occasion Colonel Pelly did not, as formerly from Teheran, wear his uniform as a British officer; but whilst not concealing his nationality, he never thrust it offensively forward, wearing the ordinary dress of the country. The first part of the journey was over a country slightly undulating, inhabited only by snakes, lizards, and insects. Grass and flowers are common enough in early spring to give a slight tinge of green to the landscape. Seven ridges of hills traversed the line of their march and extended for some distance, for they were again crossed on the return by another route. It took seven days to traverse the sandy ridges and narrow valleys, a gradual ascent all the way to a plain called Ormah, over which some brushwood was sprinkled, and through which small streams flow until they are lost in the arid soil. The plain is bounded by a ridge of hills through a ravine, in which the travellers passed to another upland plain, and this kind of progress continued until they reached Riadh, the capital, in the midst of a country studded with groves of date-palms, fifteen days after their departure from Kowait. The mean of five solar observations gives this place long. 46° 41′ 48″ and lat. 24° 38′ 34″. Colonel Pelly had three interviews with the Amir, who is absolute head of his kingdom in both spiritual and temporal matters. The Amir himself placed no obstacle in the way of scientific investigation, but his attendants are extremely bigotted and intolerant, The magnificent stud of Nejid horses was opened to the inspection of the visitors, as it had been to Mr. Palgrave.

A paper on the Korea was furnished by Captain Allen Young, who described it as an almost untrodden ground for geographers, being only known from the description of Chinese and Japanese writers, but few Europeans ever having set foot on its soil. It has been invaded and encroached upon by both those peoples, and the latter still hold a part called Fouchan, immediately opposite the most western of the Japanese islands, Tsu-sima, the prince of which is on friendly terms with the potentate of the Korea, and is looked upon as the only means of approaching this despotic and reserved prince. The French sent an embassy in 1848, but it was wrecked, and the attempt was not renewed, but both they and the Russians are expected to try to gain a footing. The produce of the country consists of fine tobacco, silk, paper, furs, cotton, hemp, rice, wheat, gold, silver, and copper; specimens of which were found in Pekin during its late occupation. Since this paper was read, the official report of the consuls in China has been published, and from this it appears that by means of the Chinese port of Newchwang, at the head of the Gulf, the Koreans obtain European manufactures, especially glass, as a substitute for their oiled paper. The interchange takes place at a fair about ten miles from the Chinese town nearest the frontier, to which place the Koreans bring gold-dust, tiger-skins, and ginsing.

The session of 1865-66 began on the 13th November last, with a few general remarks from Sir R. Murchison, the President, introductory to a paper by Mr. Baker, the Patron's or Queen's medalist of last year, and the discoverer of the second great lake in east Central Africa, which furnishes the Nile with its main body of water. Mr. Baker, who is described as sufficiently like Captain Speke in appearance to be easily mistaken for his brother by some of the African tribes, stated that he had started in 1861 to discover, if possible, the sources of the Nile.

He began by tracing the tributaries that run from Abyssinia. During the following year, he continued to ascend the White Nile, and this part of the country is much as it has been often described before: desolate, swampy, and unhealthy. At length, having reached Gondokero, much to his surprise, he met Speke and Grant, and relieved their most pressing wants. From the accounts of their success, he was encouraged to press on to try and reach the Karuma Falls that they described to him. This he at last did, and thence he followed the course of the river westward until it ran into the lake, which up to the present time has been called the Luta Nzigé, but which Mr. Baker proposes to call—for what reason we are at a loss to discover—the Albert Nyanza. This lake, which was first beheld from a height of 1,500 feet above its waters, is above 260 miles long, and about 60 broad, and is surrounded in a great part of its circuit by lofty rocks, thus differing very remarkably from most of the African lakes. The principal difficulties of Mr. Baker in the latter part of his journey originated not so much from the opposition of the natives, though this was considerable, as from the mutinying of his men, who formed themselves into bands of plunderers and joined the slave-traders. The quantity of water which issues from the lake to form the Nile is still a matter for further research.

At the next meeting of the Society, held on November 27th, Mr. Richardson read an account of an overland expedition from Rockhampton, Queensland, to Cape York, under the command of Messrs. F. and A. Jardine, which was undertaken for the purpose of discovering a route whereby live stock could be taken by land from the interior Queensland pastures to supply the new settlement of Somerset, at Cape York. The party left Rockhampton on May 14th, 1864, and reached Somerset on March 11th, 1865; they traversed the country watered by the rivers Lynd and Mitchell in October and November, and report very unfavourably of that region; farther north most of their horses died, after excessive sweating, blindness, and contraction of the stomach, apparently from eating a poisonous herb; but in January, on leaving the west coast of the gulf (lat. 14° S.), and proceeding eastward, they came to a good pastoral country, crossed several creeks, and, on the 24th of that month, discovered a new river, which they named the Jardine, flowing westward into the gulf.

Mr. Dalrymple next read a paper, "On the Establishment of a New Settlement, Cardwell, in Rockingham Bay, and on the Discovery of a Route over the Coast-range to the Valley of Lagoons," in which he described the position and physical features of the new settlement and its neighbourhood, and narrated the successful crossing of the coast-range, the discovery of a new river, which he named the Herbert, and the making of a road fit for wheeled vehicles over the pass. This road connects all the interior country, and the banks of the Flinders, Lynd, and Burdekin, with the shores of the Pacific, and is 96 miles in length.

A third paper was then read by Mr. J. P. Stow, entitled "A Boat-voyage from Adam Bay, North Australia, to Champion Bay, Western Australia." The author had been one of a large party of colonists who attempted to establish a settlement at the mouth of the Adelaide, in Adam Bay, Northern Australia; the endeavour failed completely, and the colonists quitted the isolated spot in small numbers, as opportunity offered. Mr. Stow and six others put to sea in a small boat 23½ feet long, and coasted round the northern and western shores of the continent, in the hope of reaching the settlements of Western Australia, at any rate, the new settlement in Camden Harbour, 500 miles distant. Favoured by the weather, they accomplished this first stage of their journey, and Mr. Stow graphically described the voyage, the barren nature of the intervening country, and their continued disappointment at the numerous archipelagos and islands being all equally sterile. They found a miserable state of things at Camden Harbour, the settlers being about to abandon the place, so they continued their adventurous voyage for 1,000 miles more. During this stage they met with much severe weather, including a gale of wind which lasted three days; the country continued barren until they reached Champion Bay, when it began to improve.

Previous to the reading of the papers at the third meeting of the Society this session (December 11th), Sir R. I. Murchison, President of the Society, adverted to the great loss the science of Geography had sustained by the death of the distinguished African traveller, Dr. Henry Barth.

The intelligence previously received of the disastrous termination of two African expeditions had since been to some extent contradicted, for M. du Chaillu (who is now in England) had succeeded in penetrating 200 miles farther than on his previous journey; and though an unfortunate accident had led to an encounter with the natives, he had happily saved his journals, chronometers, and records of astronomical observations. The other expedition—namely, that of the Baron von der Decken on the east coast—had certainly met with a disaster, one of the two steamers having been wrecked on the bar of the Jub; but the other and larger one had been repaired, and had conveyed the party a considerable distance up the river.

The first paper read was on "A Boat-journey along the Coast-lakes of East Madagascar," by Capt. W. Rooke, R.A. The author had heard that the chain of lakes south of Tamatave might be traversed for several hundred miles in a boat sufficiently light to be carried over the short portages, and accordingly attempted the exploration with three companions and a native crew. The journey occupied 32 days, during which the party travelled nearly 400 miles, and passed numerous villages, and several larger towns of about 1,000 inhabitants each; it was chiefly along winding channels and streams, which connected the lakes together, and whose banks were clothed with magnificent tropical vegetation, arching overhead in the narrow watercourses, and thus adding greatly to the beauty of the scenery.

Another paper, entitled "On Ankova, the Central Province of Madagascar, and on the Royal or Sacred Cities," by the Rev. W. Ellis, was then read. The province of Ankova is the most important of the twenty-two into which the island is divided, from being the country of the Hovas or dominant race; it is 150 miles in length by nearly 100 in breadth, is hilly or mountainous, the elevations rising singly or in masses, rather than forming continuous chains. Mount Ankaratra, in the south-west of Ankova, is one of the highest mountains in the island, being about 13,000 feet above the level of the sea. The author described the streams, lakes, forests, and fertile valleys between the isolated mountains, and concluded with a notice of the twelve sacred cities of Ankova, which derive their sanctity from having been the birth-places, abodes, or burial-places of their monarchs. Europeans are forbidden to enter them, and although some of them are places of large size, they have not yet been laid down on our maps. The belief in the influence of the spirits of their deceased monarchs is one of the chief features of their religion, and is stated by Mr. Ellis to enter into all their most important ceremonies, and to influence the actions and policy of royalty.

VII. GEOLOGY AND PALÆONTOLOGY.

(Including the Proceedings of the Geological Society.)

One of the most important contributions to British Geology that has appeared during the past quarter is a memoir by Mr. Searles V. Wood, jun., entitled: "Remarks in Explanation of the Map of the Upper Tertiaries of the Counties of Norfolk, Suffolk, Essex, Middlesex, Hertford, &c., &c., and accompanying Sections." In this paper the author further explains, and somewhat modifies, his classification of the glacial deposits in the east of England; but as his views have already been noticed in these Chronicles (vol. i., pp. 330 and 478), we need give no introductory explanation. He now divides the Glacial deposits into Upper, Middle, and Lower Drift; the Middle and Lower Drifts having hitherto formed his "Upper and Lower Series of the Lower Drift." A difficulty which we suggested formerly, Mr. Wood has met to some extent by calling all the more recent sands and gravels Post-glacial, a very good name as a distinction, though not strictly true. Mr. Wood's views differ considerably from those generally accepted; for instance, he is of opinion that the Chillesford beds (usually thought to be of Norwich Crag age, or a little newer) belong to his Middle Drift series. This Middle Drift is an important formation; it consists chiefly of sands and gravels, and intervenes between the Boulder-clay (Upper Drift) and Boulder-till (Lower Drift), and we should not be at all surprised at its ultimately furnishing the key to a comparison of our Glacial series with that of Scotland. The differences in the deposits of the two countries are rather remarkable (compare vol. ii., pp. 679 and 680), and an explanation of them would doubtless soon lead to a well-grounded interpretation of the whole of the phenomena of the Glacial period. Perhaps the map and numerous sections are the most valuable portions of the paper.

The upper limit of the Eocene formation, the lower boundary of the Miocene, and the question whether the Oligocene of Professor Beyrich really forms a natural group of deposits, have frequently of late years formed the subject of discussion, and even of controversy. Any contribution to the facts of the case must therefore be very welcome to all who take an interest in Tertiary Geology. Accordingly we are very glad to see published the results of Professor Reuss's examination of the German Upper Oligocene Foraminifera, Bryozoa, and Corals, which have appeared in the 'Sitzungsberichte' of the Vienna Academy (vol. i.).

Of Foraminifera the beds are known to contain 142 species, of which 67 (47 per cent.) are peculiar to that horizon, 47 (33 per cent.) occur in Middle Oligocene strata, 42 (29·5 per cent.) in Miocene deposits, 23 (16 per cent.) in Pliocene beds, and 16 (11·2 per cent.) occur at the present day. The proportion of species common to the Upper Oligocene and to the Middle does not differ, therefore, very materially from that common to the former deposit and the Miocene.

Of the Corals not much can be said; only seven species that can be determined with safety are known to Professor Reuss, of which one occurs also in the Crag of Suffolk and Antwerp, and one in the Lower Oligocene beds of Latdorf, while the remaining five are peculiar to the Upper Oligocene.

The Bryozoa are, however, much more numerous, 74 species having been determined by the author; of these, 14 species are found in the Lower, and 21 in the Middle Oligocene, 18 being also known in Miocene deposits. It will thus be seen that this evidence tends to the same conclusion as that of the Foraminifera.

The Middle Oligocene fauna does not possess the same interest as the Upper in a classificatory point of view, but Professor Reuss's more recent researches on its Foraminifera, Corals, and Bryozoa have an equal intrinsic value to the pure palæontologist.

In the 'Annals and Magazine of Natural History' for September, Dr. Duncan described six new species of Corals from the South Australian Tertiary strata. They include one new genus (*Conosmilia*), which presents certain novel structural peculiarities, and which bridges over the gaps between some of the families in the accepted classification. It "possesses the twisted ribbon-shaped columella of the sub-family *Caryophyllaceæ*, the endotheca and septal margin of the *Trochosmiliaceæ*, and the irregular septal arrangement which was so common in the Corals of the Oolitic age, and which, from its octomeral type, reflected the *Rugosa* of Palæozoic times." In this coral, therefore, we have again a trace of that Jurassic facies so characteristic of the recent Australian land-fauna. Another curious feature is seen in the only known species of this genus, namely, that the bases of the septa and the costæ are not continuous, but the septa appear to correspond with the line of depression between the costæ; but what is more remarkable still is that, according to Dr. Duncan, this feature "is common in species of other genera in Australia, but is very rare indeed in any specimens from any other part of the world." The perusal of papers containing the record of such curiosities in Natural History cannot but tempt a naturalist to speculate on their probable causes. Much might be written in an endeavour to answer the question,—What are the causes of those trivial characters, having no relation to the economy of the organism, which impress on species of certain genera, or genera of certain families, a peculiar geographical or geological stamp? For instance, Why should so many Tertiary and recent corals, peculiar to Australia, have the septa and costæ alternate instead of opposite? And why should the Jurassic species of *Cidaris* (with scarcely an exception) have crenulated summits to the bosses of the tubercles, while the Carboniferous and Cretaceous species have them smooth?

A remarkably praiseworthy paper has recently been published by Mr. T. Codrington, F.G.S., in the 'Magazine of the Wiltshire Archæological and Natural History Society,' on "The Geology of the Berks and Hants Extension and Marlborough Railways." In it the author describes all the points of interest observed during their construction, in the order in which they are met with in going from Hungerford to Devizes on the one railway, and from Savernake to Marlborough on the other. This part of his paper will be extremely useful to the geologists of the neighbourhood, and, being well done, will no doubt attract attention elsewhere; but the concluding portion, containing some general observations and conclusions respecting the formation of the Vale of Pewsey, will, in these days of "atmospheric denudation" proclivities, certainly be somewhat roughly criticized. Mr. Codrington's main conclusion is, that the Vale of Pewsey was excavated to a great extent by marine denudation, at a period between the deposition of the Lower Eocene beds and that of the Boulder-clay, the valley being of the same age as the great chalk escarpment.

'The Millstone-grit, its Fossils, and the relation it bears to other Groups of Rocks,' by Fort-Major T. Austin, F.G.S., is another pamphlet of some importance, which may also be considered a local memoir, for its contents refer chiefly to the neighbourhood of Bristol. Major Austin's long-continued search has been rewarded by the discovery of numerous fossils in this generally sterile formation. Of the forty-seven species obtained the author considers all but three to be new, and two species of Crustacea are too obscure for description. Of the so-called new species the author gives bad figures and inadequate descriptions, and we feel almost positive that the majority of them are small variations from old and well-known species. While we are glad to be able to give a large amount of praise to Major Austin for his perseverance and enthusiasm, we cannot avoid pointing out these and some other serious errors in his pamphlet. One of the sections given in the last plate bears its improbability on the face of it. The occurrence of a single fact which appears in favour of a preconceived view is too often sufficient to convince him of the correctness of his theory. Major Austin's idea of a classical name is also rather astonishing; taking, we presume, as his basis the occurrence of such generic appellations as *Cytherea* and *Venus* amongst the Lamellibranchiata, he now gives to two new genera of Brachiopods the names of *Psyche* and *Anonyma!* The reproach so often cast upon scientific men, that their writings teem with bad Latin, has originated from the abundance of such barbarisms as those coined for this pamphlet, *e. g. Cytherea minutia, Tellina antiquitus, Pinna angulatus*, &c., and the following heterogeneous series of names given to species of Pecten: *planus, flabellum, symmetria, tenuistria*, and *albidus*.

The publication of the second volume of the Palæontological part of M. Barrande's 'Système Silurien du Centre de la Bohême,' is an important event in Silurian Palæontology. It contains 107 plates, comprising figures of about 200 species of Silurian Cephalopoda, belonging to the following genera: *Goniatites*, de Haan; *Nothoceras*, Barr.; *Trochoceras*, Barr. & Hall; *Nautilus*, Linn.; *Gyroceras*, Kon.; *Hercoceras*, Barr.; *Lituites*, Breyn.; *Phragmoceras*, Brod.; *Gomphoceras*, Low.; and *Ascoceras*, Barr. Unfortunately the text does not accompany the plates, but will be published shortly; there are, however, a few notes attached to the explanation of each figure. As all the species figured are considered to be new, the appearance of the descriptions of them will be anxiously looked forward to. The present portion of this great work is as good an index as its predecessor, firstly, of the wonderful richness of the Bohemian Silurian fauna; secondly, of its distinctness from the Silurian fauna of Great Britain; and, thirdly, of the perseverance and unwearied diligence of M. Barrande.

M. Vaillant has recorded, in a paper 'Sur la Constitution géologique de quelques Terrains aux environs de Suez,' published in the Bulletin of the Geological Society of France (vol. xxii. p. 227), the discovery of shells of *Ætheria Cailliaudi*, at Chaloufs el Terraba, eighteen kilomètres from Suez: a fact of some importance in regard to the ancient course of the Nile and the antiquity of the Nile Oyster. In the same paper some interesting details are given respecting the geological constitution of the neighbourhood of Suez in the direction of the Sinai chain; but, as might have been expected, the rocks whose age has been determined belong to the Eocene and Upper Cretaceous periods.

An important work has recently been published by M. Jules Martin, entitled, "Etage Rhætien, ou zone à *Avicula contorta*, &c.;" it appeared originally in the Memoirs of the Academy of Sciences of Dijon, but has also been issued as a separate volume. The author's conclusions may be summarized as follows:—

The mineralogical transition from the zone of *Avicula contorta* to the adjoining deposits is not less complete on the side of the Infralias than on that of the Keuper.

Without exception, the deposits of this horizon are conformable both to the Trias and the Lias.

The geological movements which took place during this period began in the Triassic Epoch, and continued without interruption into the Liassic.

There is observable in the fauna a very marked predominance of affinities on the side of the Lias.

The periods of rest from biological manifestations, which occurred after the deposition of the Keuper, and after that of the zone of *Avicula contorta*, render the latter group the representative of a distinct period, and give it the value of a formation.

Its lower limit is generally well defined, whereas the boundary between it and the true Lias is in different countries more or less uncertain.

The Rhætic formation has the greatest palæontological affinity with the Lias, and therefore forms the first stage of the Jurassic series.

The last three numbers of the 'Geological Magazine' have, as usual, contained some interesting articles. Mr. Henry Woodward (the Editor) gives in the September number a description and figures of fossil "Crustacean teeth," and shows how curiously they resemble, until carefully examined, the true teeth of certain Marsupials. Mr. Carruthers has a paper in the next number on a new cone from the Coal-measures, which he makes the type of a new genus—*Flemingites*. It is allied to *Lepidostrobus*, but differs in each scale of the cone supporting a double series of roundish sporangia, whereas in that genus each scale supports only one roundish sporangium. The same author has a paper in the November number on a Fossil tree-fern from the Upper Greensand. Besides containing some observations of interest respecting the determination of the fossil, this paper is rendered worthy of notice by the author's conclusion, that the five slight constrictions seen on the stem appear to indicate an alternation of climate during the year at that remote period, similar to what we now experience. Mr. Baily's paper "On the Cambrian Rocks of the British Islands," Professor Owen's notice of M. van Beneden's "Recherches sur les Squalodons," Mr. Kinahan's notes "On Pre-glacial (?) Drift in Queen's County, Ireland," and some other articles also contain points of interest. The correspondence seems to increase in bulk and value, and no doubt forms an attractive portion of the magazine to local geologists.

PROCEEDINGS OF THE GEOLOGICAL SOCIETY.

No less than twenty-three papers are contained in the last number of the 'Quarterly Journal of the Geological Society;' we must therefore be content to notice only the more important of them in the order in which they appear.

Dr. Duncan's paper on Echinodermata from the South-eastern coast of Arabia and from Bagh on the Nerbudda is unusually interesting. This palæontologist generally makes remarks worth reading and remembering in connection with the subjects of which he treats, and those contained in this memoir exhibit a more than common breadth of mind. Finding the species he has determined to indicate a Cenomanian age, he discusses the probability of the beds containing them belonging to that period, and devotes a special section of the paper to an essay on "The Impossibility of establishing a close Synchronism between the Asiatic and other Cretaceous Strata." The remarks which follow, "On the Identity, Persistence, and Variability of the Species," are equally good and very suggestive. They at least show us how much we have to learn about the life-history of those types which we call species. The conclusion, that "as the different longevities of species and also of the individuals of species are both regulated by determinate laws, so are, doubtless, the apparently inexplicable associations of persistent, variable, nascent, and moribund species," is sufficient to indicate the nature of the subject discussed. We can here do no more than call attention to the paper, which is worthy of forming an appendix to Mr. Darwin's 'Origin of Species.'

The next paper consists of a letter "On the Fossil Contents of the Genista Cave, Gibraltar," addressed by Mr. Busk and the late Dr. Falconer to General Sir J. W. Codrington, Governor of Gibraltar. The character of the extinct fauna of Gibraltar, according to the evidence yielded by this cave, is not a little peculiar; of the Mammoth, *Rhinocéros tichorhinus*, *Ursus spelæus*, *Hyæna spelæa*, and other English, French, and German forms, "not a vestige has been detected among the fossil remains of Gibraltar." The Carnivora are, however, the most significant; "the three species of *Felis* are of African affinities, and *Hyæna brunnea*, now for the first time ascertained to have existed formerly in Europe, is at the present day chiefly found near the Cape of Good Hope and Natal." The last-mentioned discovery opens out a very large question, or series of questions. How did *Hyæna brunnea* get from Africa to Europe, or from Europe to Africa? In which of these directions did the species migrate? At what period did the migration take place? Finally, how comes it that this is a *South* African species? Human remains, stone implements of the polished-stone period, broken querns, pottery, and other objects were also found in the cave, and show that, geologically speaking, its contents are of no great antiquity. The authors conclude their letter by two very good suggestions; firstly, that a local museum should be formed, to contain objects of interest found on the rock, *and nothing else;* secondly, that a geological survey of the rock should be made by a competent surveyor. We believe that Professor Ramsay, the Director of the Geological Survey of Great Britain, has undertaken the last-mentioned task, so that we may be sure of its being well done.

Dr. Falconer's posthumous paper "On the asserted Occurrence of Human Bones in the ancient fluviatile Deposits of the Nile and Ganges" has already been noticed at some length.

Mr. Whitaker's three papers on the Chalk of the Isle of Thanet, of Bucks, and of the Isle of Wight are interesting to British geologists, but the special nature of the facts described prevents our discussing them here.

Some curious facts are mentioned in Dr. Stoliczka's paper on the Cephalopoda of the South-Indian Cretaceous Rocks, which will be read with interest in connection with Dr. Duncan's paper already noticed. It is satisfactory to find that these two palæontologists, working independently and upon different classes of animals, come to the same conclusion respecting the age of the Indian Cretaceous strata. Although none of the genera of Cephalopoda from these beds, with the exception of *Ammonites,* are represented by species which exhibit any remarkable difference from European Cretaceous forms, yet of the genus named there are four species of the group *Macrocephali,* one of the *Planulati,* and one of the *Fimbriati,* which are of course allied to Jurassic forms. "The most striking and abnormal among the Ammonites, however, are three species of the Triassic group *Globosi,*" and Dr. Stoliczka may well have been astonished at their occurrence in such company.

A great deal has lately been said for and against the theory of the atmospheric erosion of river-valleys, of the Valley of the Weald, &c.; and we now have, in Messrs. Foster and Topley's paper "On the Superficial Deposits of the Valley of the Medway, with remarks on the Denudation of the Weald," a carefully prepared account of certain phenomena which are thought by the authors to prove, or at any rate to render it probable, that the Valley of the Weald owes its present surface-configuration chiefly to atmospheric causes. There are those who theorize and speculate without a knowledge of the phenomena they wish to explain; there are again those brilliant-minded and experienced men who can propound a probable theory and support it with ability, off-hand, simply from their great knowledge of natural phenomena in various districts; but there are also those equally useful workers in science, who, like these authors, accepting a theory already rendered probable, take a particular district and find out how every individual fact lends additional probability to the view they accept. Of course, in this instance, the conclusion is foregone, but we honestly believe that had the facts proved adverse they would not have been distorted to harmonize with it. Messrs. Foster and Topley show that an old river-gravel of the Medway occurs 300 feet above the present level of the river; therefore the valley below must have been excavated by sub-aërial causes—"rain and rivers." They also go farther, and say that in this case "there can be but little difficulty in supposing the present form of the ground in the Weald to have been produced entirely by these agents;" this is not yet proven, but is to a great extent highly probable. According to the chronological statement given by the authors, Col. Greenwood was the first to maintain (in 1857) that the valleys were wholly formed by "rain and rivers;" unfortunately, however, his book was but little read by geologists at the time. The question was raised *as* a question by Mr. Jukes in 1862; but Professor Ramsay has been its great exponent and advocate, and has disposed of most of the objections to his theory that have been advanced by the advocates of marine-denudation. It must not be supposed, however, that rain and rivers are considered by him and his followers to have done all the work; the sea began, and atmospheric agencies completed it.

Two out of Mr. Henry Woodward's three papers on new fossil Crustacea are well worth notice. In one the author proves that Professor de Koninck's *Chiton Wrightianus* is not a Chiton, but a Cirripede. This fossil was found in the Wenlock limestone and shale of Dudley; it is apparently allied to *Loricula* and other pedunculated Cirripedes, and thus carries back the first appearance of the group from the Lias to the Upper Silurian.

In another paper, Mr. Woodward describes a new genus of Eurypterida, which he names *Hemiaspis*. It is remarkable on account of its appearing "to offer just the link we needed to connect the Xiphosura with the Eurypterida." The author also remarks, that "there are several peculiarities about *Hemiaspis* which seem to offer analogies with the Trilobites." In this chronicle we have thus recorded the discovery of two transition-forms—a Coral and a Crustacean, and we feel confident that the determination of such links between heretofore distinct families is destined some day to form an important element in the solution of the laws which have regulated the origin and succession of life on the globe.

VIII. MINING AND METALLURGY.

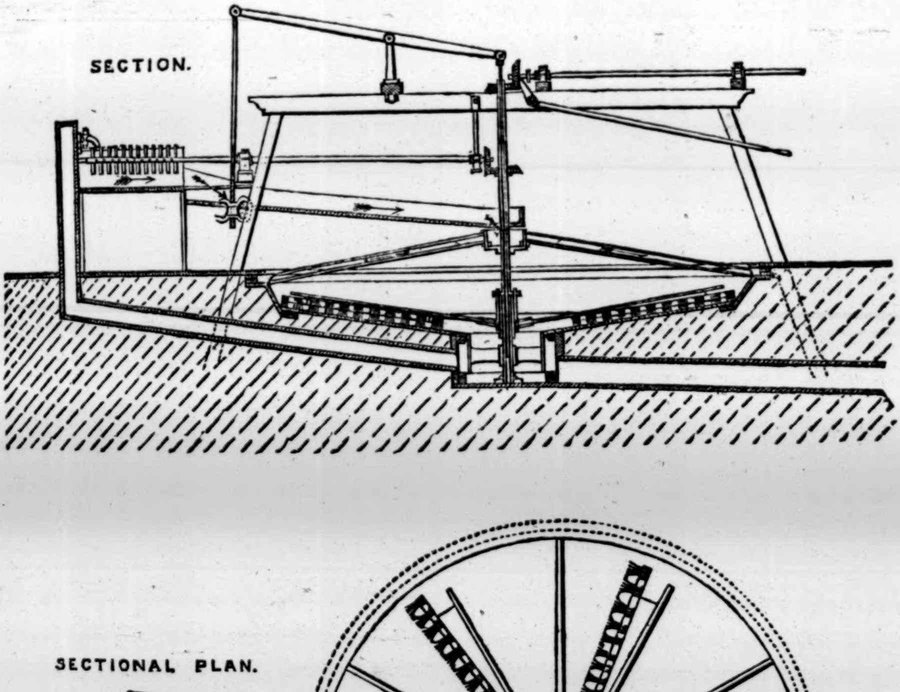
For some time past the price of Tin ore, or as it is technically termed, Black Tin, has been so exceedingly low, that throughout the tin-producing districts of the West of England during 1865 not more than six mines have been in a position to pay dividends to the adventurers. This has arisen from three causes: the failure of the American market—the large importation of tin from the Eastern Archipelago—and from the British mines forcing considerable quantities of tin upon the market, they being unable otherwise to meet the current expenses of the mines. This state of things has naturally led to a careful examination of the methods of preparing the ores for sale, with a view to the introduction of more economical methods. It is not generally known that the process of separating tin ore (oxide of tin) from the stone in which it is found is one of considerable delicacy. The quantity of tin ore is small compared with the valueless matter with which it is mixed. This will be evident from the following statement of the quantities of tin ore contained in the mass, as it is brought to the surface, from the mines named:—

Huel Kitty, St. Agnes	84	pounds of oxide	of tin in	every ton.
Dolcoath, Camborne	56	,,	,,	,,
Tincroft ditto	35	,,	,,	,,
North Roskear, ditto	25	,,	,,	,,
Huel Uny, ditto	23	,,	,,	,,
East Carn Brea, ditto	18	,,	,,	,,
Polberro Consols, St. Agnes	14	,,	,,	,,
Huel Coates, ditto	6	,,	,,	,,
Lanivet	4	,,	,,	,,

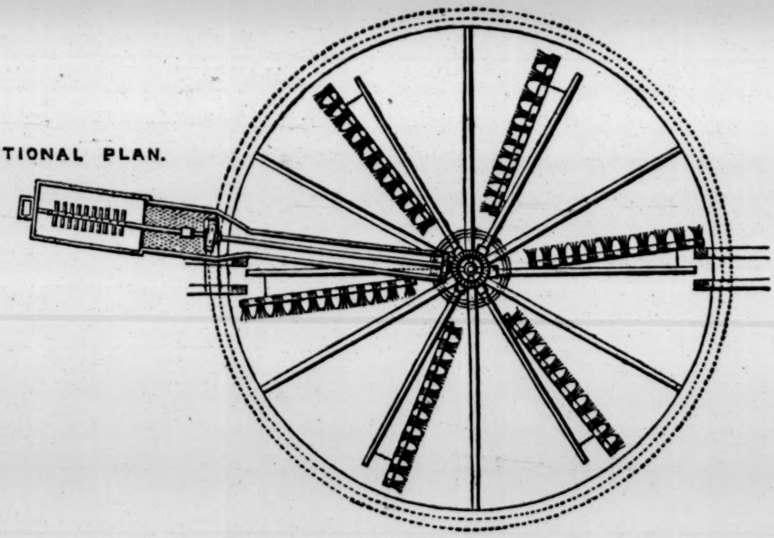
The hard quartzose contents of a mineral vein are brought to the surface from great depths, and the first operation is to reduce it to a state of fine powder, which is suspended in water. This is brought about by the continued action of heavy stamps, and the mud thus produced is made to pass through the "stamps grate" (a perforated plate of copper). This muddy fluid has usually been allowed to flow through long narrow troughs—commonly called "strips"—and when these were filled they were emptied by hand; the upper part of the strip containing the portion which was richest in tin, the lower portion being very poor. Dividing the contents of this trough and removing it to other machines, either "frames" or "buddles," was a tedious and, consequently, a costly operation.

Necessity has compelled the miner to reduce this cost as much as possible. This has been very successfully done by the use of the "round buddle," which is a circular table, or trough, slightly inclined from the centre to the circumference. The thick mud flows in at the centre, over the table, and runs off at the edges. By regulating the flow of water, and producing a slight degree of agitation by means of light brushes, which are made to sweep the surface, all the heavy matter, of course containing the tin, is deposited nearest the centre. Beyond twelve or eighteen inches from which but little tin is found.

Another form of machine has also been recently introduced, which is known as "Borlase's Buddle," being named after the inventor. This "buddle" differs from the ordinary form in delivering the fluid containing the earthy matter and the tin at the circumference, and distributing it towards the centre. The construction of this apparatus will be seen, at once, from the accompanying drawings:—



SECTION.



SECTIONAL PLAN.

By this arrangement the tin stuff in its state of fine powder in suspension in water is, at once, spread out in a thin sheet, and the heavy matter, tin ore, is disentangled from the earthy mixture; the lighter portion flowing towards the middle of the buddle, is gradually brought under the influence of an increasing flow of water and carried away. Of course in this "buddle" all the rich portion is found around the edges of the trough. It is stated that a saving of from 30 to 40 per cent. is effected by the use of Borlase's machine.

In a "Tin stream" at Mudian Vean, in St. Martin's, to the south of the Helford river, in Cornwall, there has been recently found associated with tin and titaniferous iron (Menachanite) some small pieces of gold.

A remarkable discovery of Silver ores has been made in California. It is of so startling a character that English capitalists have sent out competent persons to investigate all the conditions. Silver Peak is situated east of San Francisco, on the eastern side of the Sierra Nevada, and nearly one degree south of the city of Austin. From an American journal we obtain information from which we make our abstract.* Silver Peak is an old extinct crater 5,000 feet above the sea level; near it is an extensive deposit of salt, and not far distant a large accumulation of sulphur. At first the searchers after the precious metals confined themselves to the Pacific side of the Sierra Nevada, but discoveries in New Mexico, Arizona, and Virginia city induced a thorough examination of the east side of that range. This proved a great success, and much wealth was obtained in the neighbourhood of Austin, a city which has sprung up within three years and which is now said to contain a population of 10,000 people. Twelve exceedingly rich lodes or "ledges," as the Californian miners call them, have been found near Castle Mount. The specimens brought to New York by Colonel Catherwood are remarkable for their richness. "If there is no mistake," says the 'Journal of Commerce,' "a new deposit, superior even to the Cornstock lode, which has furnished so many millions of silver, is about to pour into our market its limitless supply of this precious metal." We shall watch the result with much interest.

Mr. A. Blatchley, mining engineer of Austin, has made a rather extensive report on the whole of that district, of which the Reese river is the centre. He informs us that all the useful metals, as gold, silver, copper, lead, antimony, mercury, arsenic, manganese, and iron, are found in abundance, and tin in small quantities.

Only five years have elapsed since the first silver was worked in this district, and last year the amount shipped from Nevada nearly equalled the amount produced in Mexico, and the production of this year will, it is said, nearly double that of last. The value of the average yield of all the ore worked in the mines of Austin is $144 per ton. Nearly every variety of silver ore known to the mineralogist is found in the vicinity of Reese river. Native silver is found as wire silver, and in thin lamina between different layers of ore, also in masses of irregular shape mixed with the ore. This latter variety is mostly found in the Revenue Mine, on Lander Hill, where pieces weighing five pounds have been found; it is also discovered in minute particles in the oxide of iron, forming the ore known in Mexico as *Colorados*. Above the water level the ores of silver are Chlorides, Iodides, Bromides, and Selenides; below the water level they are generally Sulphurets.

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* 'New York Journal of Commerce.'

The annual production of Coal, in the coal producing provinces of the Chinese empire, has been given by Mr. Mossman as follows:—

	Tons.
Che-Kiang	80,000
Kiang-See	190,000
Hoonan	260,000
Quang-tung	130,000
Northern Provinces	340,000

The value of this coal at the pit's mouth is given, in round numbers, as 1,200,000*l.*, and we learn from the same authority that the consumption of native coal in China is only one ton to every 406 persons.*

Coal is being worked by the sanction of the Viceroy of Egypt in the neighbourhood of the classic mountain Olympus. Depôts are about to be formed on the shores of the Red Sea to supply the steamers with this fuel, which is said to be of good quality, and can, it appears, be sold much cheaper than any other coal.†

METALLURGY.

At a recent meeting of the Institute of Civil Engineers of France, M. Gaudry read a paper on a new French puddling machine which has been regularly at work at the Clos-Mortier Iron Works, near St. Dizier, for four years. By this machine the ordinary puddler's "rabble" is worked regularly over the furnace door, and the tool is changed with the greatest readiness as often as this is needed. The puddler has only to watch the operation, without anything to tire him, until the time comes for him to "ball" the iron, the machine being then thrown out of action. The apparatus is placed either on the top of the furnace, or in a pit underneath, or alongside. It consists of a suspended connecting rod, which is capable of vibrating in all directions for working the rabble, and is itself worked by an arrangement of rods, shafts, and cranks supported on the brickwork. The motion is generally obtained from a driving power common to all the furnaces, by means of an intermediate shaft with pulley and strap; and at each furnace the strap is provided with a tightening lever, which is lowered or raised for starting or stopping the apparatus. By this means the rabble receives a rectilinear movement backwards and forwards across the furnace, and, at the same time, a much slower travelling motion from right to left and *vice versâ*—in the direction of the length of the furnace doors. In consequence of this double movement the rabble works over the entire furnace floor, and effects a uniform and complete stirring of the metal, with a rapidity and regularity of which few puddlers are capable.

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* From a letter to Mr. T. Y. Hall, of Newcastle-on-Tyne, from Mr. Mossman, communicated to the Birmingham Meeting of Mining Engineers.

† 'Les Mondes,' 5th October, 1865.

It is well known that a peculiar ferruginous sand is found on the coast of Taranaki, not far from Whanganni, in New Zealand. Attention has been from time to time called to this sand, which appears by analysis to consist of—

Protoxide of Iron	88·45
Oxide of Titanium and Silica . . .	11·43

Numerous difficulties attendant on smelting this ore have hitherto prevented its being employed in the manufacture of iron. It is, however, now stated that Mr. Charles Martin, C. E. of London, has successfully produced good pig-iron from the Taranaki sand by smelting it in small furnaces with coke for fuel. The examples of iron and of steel manufactured from it which have been exhibited are of a very high character, which is supposed to be mainly due to the presence of Titanium.

Amongst the most remarkable illustrations of the powers of modern Metallurgy may be noticed the fact, that on the 17th October Messrs. Bessemer and Sons, at East Greenwich, cast a cubic block of steel of the enormous weight of 100 tons. Large as this block is, it was far exceeded by what has been done at Bolton by the aid of Messrs. Ireland and Sons' patent upper twyer cupola furnace, where a block of steel weighing 250 tons was cast. This furnace melts at the rate of thirteen tons of Bessemer steel in an hour, and is charged with three hundredweight of coke to fifty hundredweight of metal. The saving of fuel is one of the advantages of these furnaces, of which there are ten at Woolwich Arsenal, effecting an economy of coke to the extent of 2,000*l.* a year. The large block of steel cast at Woolwich and another somewhat smaller are to serve as anvils for steam hammers in the works of the Messrs. Bessemer, which are now approaching completion.

'Guide Pratique des Alliages Métalliques,' by M. Guettier, Engineer and Director of Foundries, and author of 'La Fonderie en France,' has just been published at Paris. This work treats the question of alloys with much care.

M. de Cizancourt, in a paper addressed to the Academy of Sciences, puts forth a new theory of Iron and Steel. Oxides of iron have usually been considered as degrees of oxidation of the same metal; M. Cizancourt adopts a view put forward in the first instance by Berzelius, that there are two sorts of "Iron-metal," to which he respectively gave the names of *ferricum* and *ferrosum;* these are supposed to represent two allotropic states of iron. Ferrosum is the metal extracted from the protoxide of iron through the reducing agency of hydrogen; the nearest approach to this is commercial iron, being what is called "bright iron." The iron derived from the anhydrous peroxide is the metal called ferricum. The common sorts of foundry iron are supposed to be this metal with some carbon. The author says that certain kinds of cast-iron identical in their chemical composition, appear so different from each other, and give such opposite results in working them, as to compel us to distinguish them in practice. In metallurgy, M. de Cizancourt contends, the various sorts of iron are a matter of mere secondary importance; the real characteristic to be taken into account being, the degree of oxidation of the ore, from which they have been extracted. Malleable iron is supposed to be formed of mixtures in variable quantities of the two kinds of iron which pass into the state of "ferricum." Steel is also supposed, according to M. Cizancourt's view, to be a reunion of the two conditions of iron; the metal being the more perfect the nearer the two irons unite in the proportions in which they exist in the mineral state.

MINERALOGY.

For some time past attention has been directed to a remarkable phosphatic mineral, discovered near Cwmgynen, about sixteen miles from Oswestry.

It occurs as a nearly perpendicular vein in a dark bituminous limestone. The following analyses of this mineral have been published by Dr. T. L. Phipson*:—Nos. 1 and 2 were solid specimens, weighing several pounds, taken from different localities; No. 3 was a powdered specimen from another part of the mine; while No. 4 is a mean analysis of three other district specimens.

	I.	II.	III.	IV.
Water	8·00	3·00	6·00	5·00
Phosphate of Iron	29·40	19·00	27·00	14·60
Phosphate of Lime	13·00	50·00	—	—
Lime	—	—	21·91	17·43
Silicate of Alumina	44·00	26·00	22·02	38·60
Protoxide of Iron	—	—	20·88	9·87
Carbonates of Iron, Lime, &c.	5·60	2·00	2·19	14·15
	100·00	100·00	100·00	100·00

This mineral is evidently a compound of phosphoric acid with iron and lime in variable proportions, the one substituting the other in a very uncertain manner. The composition of the mineral cannot indeed be determined until more exact analyses shall have been made.

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* See 'Reader,' October 21, 1865. See 'Chemical News' also.

The discovery ~~of a mineral~~ resembling the celebrated Bog Head coal in New South Wales, and the manufacture of paraffine oil from it, is now exciting much attention in the Australian colonies.

A colonial paper* states that this mineral is found near Hartley, and also near Wollongong. The seam near Hartley is five-and-a-half feet in thickness, and is worked through a tunnel. This mineral is of a dark-brownish colour; it is very tough, so that if struck with a hammer the implement will bound off as it would from a block of wood; it has a conchoidal fracture, and does not powder when broken. This Hartley mineral is stated to be superior to the Bog Head coal, in consequence of its yielding a larger quantity of gas, and therefore of oil, and also of its freeness from sulphur. The importation of paraffine oil into Australia is large, and it is confidently believed that the oil can now be produced at a lower price in the colony than it can be imported from America.

"On the Growth of Flos Ferri, or Corolloidal Arragonite," is the title of a paper by Mr. W. Wallace, of the Silver Band and Dufton Mines, well known by his work on 'Metalliferous Deposits of Alston Moor,' which was read before the Geological Society of London, and is published in the November number of their journal.†

It is not possible to condense Mr. Wallace's views. It may be briefly stated that he considers the growth of arragonite to be from within and not from without as has been usually thought. "Arragonite growing in an atmosphere may be considered a type of vegetation, the forms of which it more especially mimics."

Dr. Gustav Tschermak has published "Chemico-Mineralogical Researches on the Felspars." ‡ The author believes that with the exception of Hyalophane and Dauburite, all the Felspars may be resolved into mixtures of three true species or *genera* as he terms them, namely, those known in the pure state as Adularia, Albite, and Anorthite, Soda, and Lime Felspars. The potash Felspars he considers to be the result of regular alternations of Orthoclase with Albite; and the other Felspars to be isomorphous mixtures of Albite with Anorthite, sometimes with small quantities of Orthoclase. Oligoclase; Andesine, and Labradorite appear to be merely members of a great series in which many transition forms occur.§

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* 'Sydney Herald and Sydney Mail.'

† 'Quarterly Journal of the Geological Society,' No. 84, p 413.

‡ 'Chemisch-Mineralogische Studien.' Von Dr. Gustav Tschermak.

§ 'The Journal of the Chemical Society,' October, 1865.

Professor Church has recently brought before the Chemical Society a communication, entitled "Chemical Researches on some New and Rare Cornish Minerals." Hydrated Cerous Phosphate is a new mineral found by Mr. Talling, of Lostwithiel, some time ago. It occurs in a copper lode on quartz and killas. The general lustre of the mineral is vitreous; but the conspicuousness of the end-faces with a brilliant pearly lustre causes the general aspect of the grouped crystals to be splendent. The crystals are doubly refractive, but no specimen has yet been obtained capable of affording indications as to the number and direction of the optic axes. For the same reason they have not yet been examined as to the presence or absence of pleochroism. The colour of the mineral is a pale smoky grey, with a faint tinge of flesh red; the streak and powder are white. The hardness of the mineral slightly exceeds 3; it distinctly abrades a cleavage surface of calcite. The density has not been determined with accuracy, but it is about 3·14.

Professor Church's analyses give the following as the mean percentages:—

$Ce''O$	51·87
$Ca''O$	5·42
P_2O_5	28·48
H_2O	14·93
	100·70

As Professor Church says, "The occurrence of a British mineral rich in Cerium is, of course, of considerable interest, but the complete novelty of the species, as a *hydrated* phosphate of the metal, attracts particular attention, the known phosphates, cryptolite, monazite, &c., being when quite unaltered and pure completely anhydrous."

Mr. Talling supplied Professor Church with a mass of quartz crystals mixed with iron and copper Pyrites, partly covered with Childrenite, and containing, moreover, in numerous cavities and fissures a light and soft white powder. This powder was found to contain lime, alumina, phosphoric acid, and water, together with a trace of iron. The experimental percentages obtained by analysis were:—

$Ca''O$	36·27
Al'''_2O_3	22·40
P_2O_5	30·36
H_2O	12·00
	101·03

The only known mineral phosphate resembling the present is one examined by Damour in 1853, and believed by him to be a hydrous phosphate of alumina and lime. Damour's phosphate was found in the Diamond Sands of Bahia. The present mineral was obtained from near Tavistock, Devonshire.

"*Bayldonite*" is the name proposed by Professor Church for a new

Cornish mineral, which appears to be a *Hydrated Plumbo-cupric Arsenate.* "Although many mineral species are double compounds of copper and lead (Caledonite, Chileite, Linarite, Vauquelinite, &c.), yet I am not aware of any double arsenate of lead and copper, definite and constant in composition, having been yet discovered and described." (Church.) Bayldonite occurs in minute mammillary concretions having a dusty surface. The structure of the masses is often somewhat reticulated after the manner occasionally observed in certain Travertines. The fracture is slightly conchoidal, uneven, translucent on the edges; colour, grass-green to blackish green; colour of the powder, siskin-green to apple-green; hardness, about 4·5; specific gravity, 5·35; analytical percentages as follows:—

$Pb''O$	30·13
$Cu''O$	30·88
As_2O_5	31·76
H_2O	4·58
Ferric Oxide and loss	2·65
	100·00

Petroleum is being found in numerous new districts. In California it is discovered in the county of Santa Clara, not far from Gilroy, and a few miles from the route opened between San Juan and Monterey. The sources are on each side of a deep ravine, on the sides of a little river, a tributary to the Panjaro. It is stated that from 20 to 30 barrels of "oil" are obtained in twenty-four hours, but that a much larger quantity was readily obtainable.

A company has been formed for exploring the sources of Petroleum, which are said to be abundant in Zante, one of the Ionian Islands. The occurrence of petroleum in Zante was known at least 2,000 years since, for Herodotus correctly describes the bituminous springs.

An important paper "On the Ores of Manganese and their Uses," appears in the 'Transactions of the Nova Scotian Institute of Natural Science.' An abstract of this paper is given in the 'Chemical News,' November 17th.

Mr. C. Greville Williams has demonstrated the existence of Didymium in "Churchite," as the oxide of Cerium discovered by Professor Church has been called.

Bismuth is said to have been discovered in Spencer's Gulf, South Australia, where a mine is now vigorously working and likely to prove profitable.*

Mr. George Maw, of Broseley, communicates some interesting particulars relative to the occurrence of a very white sand, which is a "perfectly pure form of native silica," occurring in Talargoch mine, near Prestatyn, in Flintshire. One of the lodes in this mine running east and west, nearly vertical and from three to six feet wide, is almost entirely occupied with this silicious sand of the most perfect purity and lustrous whiteness.

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* 'South Australian Register,' September 27, 1865.

An interesting series of experiments "On the Thermo-Electric Tension of Minerals," by Walter Flight, D.Sc., will be found communicated to the 'Philosophical Magazine' for November.

On the line of railway from Estremadura to Portugal occur considerable deposits of Phosphate of Lime. This phosphate of lime attains its maximum of 85 per cent. in the formation of Montanches, six leagues from Caceres and eight miles from Logrosan, its minimum being about 50 per cent. This has been described by M. Luna.* This phosphate is found in the cretaceous strata, and is in great abundance in the silicious bed; it presents a fibrous texture. The following analyses are given:—

	Caceres.	Montanches.
Tribasic Phosphate of Lime . .	72·10	85·03
Oxide of Iron, Silica, &c. . . .	3·85	2·40
Water	3·00	2·22
Carbonate of Lime	—	10·35
Residue insoluble in Nitric Acid .	47·02	—

IX. PHYSICS.

Light.—Professor Mitscherlich has greatly extended the powers of spectrum analysis, by applying it to the detection of the electro-negative elements, chlorine, bromine, and iodine.

The difficulty of recognizing small amounts of these elements in a mixture of haloid salts is well known, and it is found impossible to detect mere traces of these bodies in such mixtures by any hitherto known method. The following means, however, will recognize the smallest amounts of these substances by the use of spectrum apparatus.

The haloid salts of copper are the most difficult to decompose by heat, and they are therefore to be preferred for spectrum investigations, which are best made in the following way:—The substance to be examined, well dried, is intimately mixed with half its weight of sulphate of ammonia and one-tenth its weight of oxide of copper. The mixture is placed in a globular enlargement of a combustion-tube, one end of which is connected with a hydrogen gasometer, the opposite end being open. A stream of hydrogen is passed through the tube, and heat gradually applied to the mixture. The hydrogen being ignited, the first appearance seen in the spectrum apparatus is a brightness in the green, in which, however, no definite spectrum can be perceived, but afterwards the spectrum of the haloid salt of copper is distinctly visible.

When present in small amount, the chlorine compound is best recognized by the lines at 105 and 109 and by the brightness near 85 and 87; the bromide compound is detected by the brightness at 85, $88\frac{1}{2}$, and 92; and iodide of copper by the brilliancy at 96, 99, and $102\frac{1}{2}$.

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* 'Compte Rendus.'

By this method, and without further trouble, $\frac{1}{4}$ per cent. chlorine, $\frac{1}{2}$ per cent. bromine, and 1 per cent. of iodine are easily recognized, and a practised observer may detect much smaller quantities.

When the haloids are mixed with each other in very small proportions, it is better to precipitate them first by a silver salt. Mix the dried precipitate intimately with twice its weight of oxide of copper, and employ this mixture in the hydrogen before described. By this method as little as $\frac{1}{10}$th per cent. of chlorine, $\frac{1}{9}$th per cent. of bromine, and $\frac{1}{8}$th per cent. of iodine in the silver precipitate can be recognized.

The spectra of the haloid salts appear consecutively, that of the chloride first, then that of the bromide, and lastly that of the iodide of copper. Their appearance in this order depends on the different volatility of these salts. Chloride of copper volatilizes considerably below a red heat, the bromide somewhere near redness, and the iodide at a low red heat. The slower the volatilization is conducted, the more certain are the results of the analysis.

When only traces of iodine and bromine compounds are present in a large excess of a chlorine compound, about the tenth of a gramme of nitrate of silver should be added to the solution. The greater part of the iodine and bromine will be found in the precipitate, which may be tested as before described.

The following results will serve as an illustration of the accuracy and precision of the process. To a pound of common salt which contained no bromine five milligrammes of bromide of sodium were added, and to the solution one decigramme of nitrate of silver. The precipitate was tested in the way just described, and after the spectrum of chloride of copper had been observed for some time, the spectrum of bromide of copper was distinctly visible for five minutes. A further addition of nitrate of silver to the solution gave a precipitate which showed the spectrum for six minutes.

Similar experiments made with iodine compounds gave equally conclusive results, and proved that a ten-millionth part of iodine or bromine may be detected in chloride of sodium.

The residue of six and a half pounds of sea water taken off Heligoland showed the spectrum of the bromide for seven minutes. Iodine could not be recognized, probably because the quantity of water was too small.

A small quantity of water from the Dead Sea showed a large proportion of bromine, but no iodine. The mother-liquor from some salt works showed much bromine, but no iodine.

Some valuable contributions to our knowledge of spectrum analysis have likewise been made by M. E. Diacon. Like Mitscherlich, he has studied the influence of the electro-negative elements on the spectra of metals, most of the researches hitherto communicated having been directed to the electro-positive elements only. The method of analysis founded by Kirchhoff and Bunsen on spectrum observations has given results so remarkable that its utility in chemical researches is not to be contested. Nevertheless, the principle on which it rests is only true under certain determined conditions. From the observations of the author and of M. Mitscherlich, it seems certain that the different compounds of a metal do not exhibit an identical spectrum, and in this paper M. Diacon has collected the experiments which show the influence of the electro-negative element on the radiations emitted by different salts of the same metal. From these experiments, which are far too numerous to admit of being given here in abstract, two consequences result:—

1. The spectra given by Kirchhoff and Bunsen for those of the alkaline earthy metals being the appearances observed at the moment the salt is introduced into the flame, it follows that such spectra must be a mixture of the spectrum of the chlorides and of that of the metal; 2. The appearance of lines not belonging to the metal may be considered as a probable, if not a certain, indication of the existence of a spectrum peculiar to the compound with which it is produced. Thus the study of the lines produced by bromides, iodides, and fluorides in the gas flame may give valuable indications, and furnish new proofs of the existence of a special spectrum for binary compounds. All the metals do not lend themselves with equal facility to these experiments. The best defined results are obtained with the alkaline earthy metals, and with copper and bismuth.

The attentive study of the light emitted by the bromides, iodides, and fluorides demonstrates, then, that the introduction of those salts into a flame determines the appearance of lines which do not exist either in the spectrum of the metals or in that of the chloride. We must, therefore, conclude that these compounds, like the chloride, have peculiar spectra, the superposition of which on that of the metal gives the appearance observed in each of them.

From the author's experiments we learn that spectrum observations give us the means of determining not only the metal but the electro-negative element combined with it. Unfortunately, very definite results are only obtained with a few of these compounds. Although the spectra of the chloride and bromide of copper are very much alike, it is easy to distinguish one from the other, and there are differences in the two spectra easily to distinguish without having recourse to measurement. For example, the position of the greenish blue lines is characteristic of the bromide, that of the violet lines for the chloride. When the two salts are placed in the flame simultaneously, the green lines of the bromide predominate at the first instant; the first of the double indigo line of the chloride is visible; the superposition of the more refrangible rays of the two spectra give rise to new appearances. The presence of the iodide of copper produces no change of importance; and thus it is easy to recognize at least a chloride and a bromide in a mixture of the three salts.

Iodide of bismuth gives the clearest indication of iodine; the spectrum of the salt up to 130 is often ill-defined and difficult to distinguish from the same part of the bromide and chloride spectrum; but the beautiful violet band which terminates that of the iodide is a convincing proof of the presence of iodine.

Fluoride of calcium must always be used to show the spectrum of fluorine. The green line situated about 121 is very brilliant when a very high temperature is employed, and may be considered characteristic of this metalloid.

In some cases the author recommends precipitation with nitrate of silver, but instead of using the silver precipitated in the manner directed by Mitscherlich (see *ante*), he treats it with sulphuretted hydrogen, saturates one part of the acid liquor with oxide of copper, and the other with freshly precipitated oxide of bismuth. The liquid or the dry residue of evaporation may be tested directly in the flame, the one for chlorine and bromine, the other for iodine, as indicated above.

Lastly, M. Diacon repeats that the spectra given by Kirchhoff and Bunsen for the alkaline-earthy metals are a mixture of the spectra of the oxide and the chloride, as are also the spectra given by Mitscherlich as those of the chlorides. In the former, he says, the spectrum of the oxide predominates; in the second, that of the chlorides. A metal, he states, may give different systems of lines, according to the experimental conditions or the nature of the compound experimented upon, and no absolutely specific character can be attached to the spectra given by Kirchhoff and Bunsen; they can only be considered characteristic of the conditions under which they were observed.

The nature of the invisible photographic image has been a never-ceasing subject for discussion amongst scientific photographers. Lately, Mr. Carey Lea,[*] an experimentalist who stands in the first rank as chemist-photographer, has tried some experiments, which to his mind seem to finally settle the long-contested question as to the nature of the invisible photographic image. The view that the change which takes place in iodo-bromized plates in the camera is a purely physical one, that no chemical decomposition takes place, and neither liberation of iodine nor reduction of silver, has obtained a pretty general acceptance. But latterly it has been opposed by two distinguished photographers, Dr. Vogel and Major Russel. The former affirms that iodide of silver is never sensitive unless there is a body present capable of taking iodine from it under the influence of light. And the latter believes that the developed image is chiefly produced at the expense of the silver haloïd in the film.

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[*] 'American Journal of Science and Art.' vol. xi., No. 118.

The following experiments seem to Mr. Lea to decisively close this controversy in favour of the physical theory:—

Experiment 1.—If the iodide or bromide of silver in the film undergoes decomposition in the camera, and, still more, if the developed image is formed at its expense, the film of iodide-bromide must necessarily be greatly consumed in the development under the dense portions of the negative which it has contributed to form.

To settle this point, an iodo-bromized plate was exposed and developed in the ordinary manner. Then, instead of removing the unchanged iodide and bromide by fixing in the ordinary manner, the developed image was removed, without affecting the iodide and bromide, with the aid of a very weak solution of acid pernitrate of mercury. Now, if the iodide or bromide, or both, had been in any way decomposed, to form, or aid in forming, the developed negative image, when this came to be removed there should have been left a more or less distinct positive image, depending upon varying thicknesses of iodide and bromide in the film, like a fixed negative that had been completely iodized. Nothing of this sort was visible, the film was perfectly uniform, just as dense where an intense sky had been as in those parts which had scarcely received any actinic impression, and looking exactly as it did when it first left the camera, and before any developer had been applied.

Experiment 2.—A plate was treated in all respects as in No. 1, except that the application of the nitrate of mercury for removing the developed image was made by yellow light. The plate, now showing nothing but a uniform yellow film, was carefully washed, and an iron developer, to which nitrate of silver and citric acid had been added, was applied. In this way the original image was reproduced, and came out quite clearly with all its details.

Now, as every trace of a picture and all reduced silver had been removed by the nitrate of mercury, it is by this experiment absolutely demonstrated that the image is a purely physical one, and that after having served to produce one picture, that picture may be dissolved off, and the same physical impression may be made to produce a second picture by a simple application of a developing agent.

Mr. F. H. Wenham, a gentleman well known in all scientific circles by his admirable device for securing binocular vision in the microscope, has communicated to the Microscopical Society some interesting notes on the Fracture of Polished Glass Surface.

It is a fact known to the philosophical instrument makers that if a metal wire be drawn through a glass tube, a few hours afterwards the tube will burst into fragments. The annealed glass tubes used for the water-gauges of steam-boilers are sometimes destroyed in this way, after the act of forcing a piece of cotton waste through them with a wire for the purpose of cleaning the bore. This will not happen if a piece of soft wood is employed. After having drawn the point of a steel burnisher over the surface of a slip of polished glass, the following appearances will be observed under the microscope, using the polarizing apparatus and selenite, with a two-thirds object-glass. A coloured stripe is visible in the passage of the burnisher, showing that the surface of the glass has been placed in a state of tension in the direction of the line. The glass, too, seems not altogether devoid of plasticity, for the waves of colour show that it has been carried forward in ripples, resembling the mark left on a leather-bound book after the passage of a blunt point. It may be inferred from this that the mere burnishing of the surface of the glass with a substance inferior in hardness will, without any scratching, cause an irregular strain in the bore of tubes sufficient to split them, and the concussion attendant upon the fracture often reduces the tube to small fragments.

If the burnished lines upon the glass slip be examined a few days afterwards, the colours will have become much less visible, showing that the strained portions of the glass partly recovers its equilibrium.

On attempting to polish out a minute scratch on the surface of a piece of glass, it sometimes appears to widen during the process, and at length resolves itself into two irregular parallel rows. Also, a clear cut made with a diamond on a piece of plate-glass, if left for a time, the surface in the vicinity of the cut will break up, forming a coarse irregular line. If the diamond be raised and struck lightly on the surface of the glass, the form of the edges of the short stroke thus made may be plainly seen, using the binocular polariscope. A conical ridge of glass appears to be left with its apex under the line of the cut, and the glass is frequently wedged up on both sides of the ridge, explaining the cause of the double line of fracture which sometimes makes its appearance in polishing out a scratch. This effect may also be exemplified by observing the marks left on a polished glass surface from the light blows of a steel centre-punch. The point of the punch drives in an atom of glass, and the fracture extends some distance into the interior, expanding downwards in the form of a truncated cone. The polariscope shows that the conical centre is in a state of compression, and that the surrounding exterior portion of glass is also under strain.

The smooth, round edge of a glazier's diamond, when drawn of a polished glass surface, burnishes down and compresses the glass beneath the cut, and in the case of thin sheets the wedge-like force of the compressed line splits the glass nearly through; but when the glass is thick and rigid, as plate-glass, unless the sheet is bent back and broken through immediately after the cut, greater difficulty will be experienced if allowed to remain for a time, for the compressed line of glass will speedily tear up the portion on both sides, leaving a wide ragged groove in place of the original clean and scarcely visible line.

A paper on the Spectrum of Nitrogen has been communicated to the Parisian Chemical Society by M. Waltenhofen, who states that in an atmosphere of nitrogen properly rarefied, the violet rays disappear before the blue and green. The author's observations lead him to believe that nitrogen is a compound body. This opinion is gradually gaining ground amongst physicists who have paid attention to the electrical spectra afforded by nitrogen under varying conditions of rarefaction and intensity.

HEAT.—A discussion has lately taken place before the Manchester Literary and Philosophical Society respecting the possibility of utilizing the internal heat of the earth as a source of motive power. Mr. G. Greaves, M.R.C.S., at the October meeting of the Society, stated that it had been very generally admitted that coal will not cease to be furnished because of the exhaustion of the stores of the mineral now existing in the coal measures; and further, that the obstacles to the continued working of the mines will not be engineering difficulties. The increased depth from which the coal will have to be brought may add to the cost, but at that increased cost it will still be for a long time obtainable. The author considered the real unsurmountable obstacle to be the high temperature of the lower portions of the carboniferous strata. The temperature had been shown to be at a depth of 4,000 feet, at least 120° Fahr., a degree of heat in which human beings cannot exist for any length of time, much less use any exertion. It had occurred to the author to inquire whether the very agency which will prevent the continued supply of fossil fuel might not be made the means of rendering that supply unnecessary—whether, in short, the internal heat of the earth might not to some extent be utilized. One or two modes of doing this had presented themselves to his mind. One of these might, he conceived, be the direct production of steam-power by bringing a supply of water from the surface in contact with the heated strata by means of artesian borings or otherwise.

This elicited a letter from Sir J. F. W. Herschel, saying that by employing condensed air, conveyed through conducting pipes, as a mode of working machinery at that depth—provided the air immediately on its condensation, and before its introduction into the pit, were drained of the heat developed in the act of condensation, by leading it, in pipes exposing a large external surface, through a sufficiently large supply of cold water (or in winter time of snow), the workings below might be sufficiently reduced in temperature by the re-expansion of the air on its escape, when given out below in the act of working the machinery, to admit of workmen remaining there in comfort; at the same time the ventilation could be supplied. Water at 120° Fahr., or even much higher, would, he feared, afford but an inefficient moving power, unless some means could be devised (without the expense of more power than the gain expected) of concentrating the heat of a large quantity of warm water into a smaller. This might, perhaps, be done through the intervention of air alternately rarefied and condensed. In the discussion on this letter Mr. Binney said that at the present time little was known as to the difficulties we should experience in working coal mines at a depth of 4,000 feet from the surface. The exact increase of temperature in deep mines was not by any means well ascertained. All we can say is, that no great difficulties have been found in working at a depth of 2,100 feet. It must always be borne in mind that the deeper a mine is the greater will be the natural ventilation; that is, the current caused by the air of the mine, at say a temperature of 80° Fahr., ascending the upcast shaft, while the air at the surface, of 40°, descends by the downcast shaft. No doubt a mine might be cooled by the expansion of compressed air, but it could not, so far as at present known, be done economically. In most deep mines a considerable cooling of the air takes place by the expansion of the compressed gas (light carburetted hydrogen) as it escapes from the coal, where it has been long imprisoned under great pressure; and this has not always been allowed for by observers of temperature in such places.

Mr. Pouchet has given the result of some very important experiments on the congelation of animals to the French Academy. The experiments entirely negative the popular idea that an animal slowly congealed may be kept so, and restored to life at any future time by careful thawing; and show that an animal whose body is reduced to the freezing point throughout, is killed beyond all chance of revivification. The experiments have great physiological interest, and our readers will no doubt be glad to learn the author's conclusions. These are:—

1. That the first phenomenon produced by cold is a contraction of the capillary vessels to such an extent that a globule of blood cannot enter, these vessels therefore remain completely empty.

2. The second phenomenon is an alteration of the blood globules, which amounts to their complete disorganization.

3. Every animal completely frozen is absolutely dead, and no power can reanimate it.

4. When only a part is frozen, that part is destroyed by gangrene.

5. If the part frozen is not extensive, and only a few disorganized blood globules pass into the circulation, the animal may recover.

6. But if, on the contrary, the frozen part is of considerable extent, then the mass of altered globules brought into the circulation when the part is thawed, rapidly kills the animal.

7. For this reason a half-frozen animal may live a long time if maintained in the condition, since the altered globules do not get into the circulation, but it expires rapidly as soon as the frozen part is thawed.

8. In all cases of congelation, death is due to the alteration of the blood globules, and not to any effect on the nervous system.

9. It results from these facts that the less rapidly a frozen part is thawed, the more slowly the altered globules find their way into the circulation, and the greater are the chances of the recovery of the animal.

The Abbé Moigno gives, in his valuable review 'Les Mondes,' a short description of an ice-making machine now in operation here. The inventor, M. Menard, employs ether, which is compressed to the extent of from five to seven atmospheres. From the reservoir the liquid is allowed to escape into a worm, circulating round square vessels of water, which become frozen by vaporization of the ether in the worm. The machine will produce, it is said, fifty kilogrammes of ice per hour.

ELECTRICITY. — The highly electro-positive metal Magnesium would be invaluable to electricians if it could be got for the same price as zinc; already it is being proposed for use in certain electrical apparatus, and at a recent meeting of the French Academy, M. Bultinck presented a note on the Use of Magnesium in Voltaic Piles in place of Zinc. The author shows that a short chain of twenty elements, each composed of thirty-five millimetres of thin silver and magnesium wires, wound about pieces of caoutchouc and properly connected, will produce all the effects, chemical, physical, and physiological, of a long Pulvermacher's chain when simply moistened with pure water.

It is announced that the two lighthouses at Havre will now be definitely illuminated by electricity, that all difficulties in the way of producing a constant light by induction machines have now been overcome by the Alliance Company. The machines will be driven by a six-horse power locomotive engine, which will also compress air for whistles or trumpets to be used as fog signals.

X. ZOOLOGY AND ANIMAL PHYSIOLOGY, INCLUDING MICROSCOPY.

THE Boston Society of Natural History have issued the subjects for the Walker prizes, *viz.* Annual prizes of sixty and fifty dollars;—subject for 1865-66: "Adduce and discuss the evidences of the coexistence of man and extinct animals, with a view of determining the limits of his antiquity;"—for 1866-67: "The fertilization of plants by the agency of insects, in reference both to cases where this agency is absolutely necessary, and where it is only accessory." There is also a grand honorary prize for 1870, to which the sum of 500 dollars may be awarded, for such scientific investigation or discovery in natural history as they may think deserving thereof, provided such investigation shall have first been made known and published in the United States of America. In case the merit of the investigation or discovery be extraordinary, the Council may award 1,000 dollars.

Mr. J. G. Shute has made an interesting communication to the Boston Society of Natural History, upon the method of transference of the new-born marsupial into the maternal pouch. It was seen by him to take place in the case of the opossum (didelphys virginica). During the delivery of the young the parent lay upon the right side, with the body curved in such a manner as to bring the vulva nearly opposite the mouth of the pouch, which was opened, or drawn down, by contraction of the muscles, so as to receive the young when delivered. The young ones were seven in number, and the time occupied in the delivery about four hours. The parent remained in the same position about thirty-six hours, and refused all sustenance. Immediately after the transfer of the young to the pouch Mr. Shute removed one, by detaching it from the teat, in order to ascertain if the movement of the fœtus was instinctive. He found that it was at least partly voluntary, as it made an effort to regain its place in the pouch; and the same movement was made on the part of the parent to receive it as at first. He did not notice any use of the lips or limbs of the parent during the transfer.

The Rev. Professor Haughton, who lately made some curious researches into the anatomy of the leg of the ostrich, with a view to discover the secret of its singular movements, has carried on his observations by examining the hind-leg of the crocodile. To this, he says, he was incited by the late Professor Gratiolet, who assured him he should find in it a problem, exceeding in complexity that presented by the leg of the ostrich. In the Annals of Natural History he details the description of the muscles, and finds the prediction of the anatomist fully borne out. The interlacing of the muscles in the thigh and leg of the crocodile is, he says, very remarkable, and even more complex than in the ostrich. At first he was disposed to think it threw some doubt upon the explanation he had previously given of the reason for such an arrangement in the bird's leg, as there did not appear so much reason for it in the case of the crocodile; but he subsequently came to an enormous deep muscle (the extensor femoris caudalis), originating from the transverse and inferior spinous processes of the caudal vertebræ, and inserted into the back of the upper part of the femur, and into a great round tendon, which, passing down the back of the femur, is inserted by a common aponeurosis into the outer condyle and the head of the fibula. The effect of the interlacing of the tendons of the various muscles is to produce simultaneity of action among them, as in the ostrich; and in the crocodile there seems to be a similar principle involved. The crocodile, resting on mud, progresses chiefly by using his hind feet as paddles; and in this use of them, the great caudal extensor of the thigh is the most powerful and important muscle employed. The simultaneity of action of all parts of the leg, rendered necessary by the employment of so powerful a muscle, is fully secured by the interlacing of the tendons, which renders it impossible for one set of muscles to act without the others being also exerted.

M. Matteucci gives an account, in 'Comptes Rendus,' of some experiments upon the electro-motor power organs of the Torpedo, in a state of repose, *i. e.* which gave no sensible discharge to a delicate galvanometer; and he finds under certain circumstances that a constant current is present, which deflects the galvanometer with a persistent deviation. This electro-motor power notably increases after the piece of the organ has been forced to give a discharge by irritating the nerves. And in torpedos taken in warm seasons, when out of water they very rapidly lose their electric function, and the electro-motor power of which is almost nil, by irritating the nerves of the organ, or by rounding the fourth (electric) lobe, the electro-motor power suddenly reappeared, and persisted for some time. M. Matteucci has endeavoured to verify the observations of M. Robin, made some years back, with regard to the organs analogous to the electric organ of the Torpedo, which he supposed to be possessed in certain rays. He had already tried without success, but supposing the failure might possibly be owing to his having operated on very small and sluggish fish, he, with the assistance of M. Schiff, operated upon a tolerably large and vivacious ray, and having forced the fish to a series of strong contractions, M. Matteucci obtained, by the galvanoscopic frog, the exposed nerve of which was placed upon the organ in question, manifest signs of electric discharges. This experiment he pledges himself to repeat and corroborate, and remarks that the difference in the dimensions and number of the elementary cellules, and the nerves of the electric organ of the ray and those of the other electric fishes gives a great importance to the study of that function in the ray, and this study should explain the peculiar electric phenomena discovered by M. Robin in the electric function of the ray, and which are not exemplified in the other electric fishes.

Dr. Mörch proposes a new classification of the Mollusca ('Annals,' December), inasmuch as he regards the organs employed in adopted classifications to have less systematic value than is usually attributed to them. The locomotive organs, on which were founded Cuvier's primary divisions, Cephalopoda, Gasteropoda, &c., have been found by subsequent researches to have been somewhat misunderstood, at all events in their homological relations. Thus, Lovén and Huxley have shown that the Pteropods are true Gasteropods, and that the funnel of the Cephalopods is homologous with the foot of the Gymnosomata. The secondary divisions (or orders) of Cuvier were founded upon the respiratory organs, but special organs for this function are not always necessary. In Mollusca not requiring a hard covering for their protection, respiration takes place through the skin; but when the skin is thickened, or the shell developed, a respiratory organ becomes necessary. The larger the shell is in proportion to the uncovered parts of the animal, the more complicated and compressed are the gills. The insignificance of the gills as a systematic character is evident by comparing the Heteropoda, from the entirely gill-less Firoloids and Pterotrachæa with external gills, to Atlanta exhibiting perfectly internal gills. The two kinds of respiratory organs indicate only relative superiority and inferiority, but not the limits of systematic division. Neither is the presence or absence of a head, though indicating relative superiority or inferiority, sufficient for natural divisions. Dr. Mörch, after twenty years' study, is enabled to state that the heart and generative organs offer characters of a much higher systematic value than is generally believed, and the classification proposed by him is chiefly founded upon the male organ, which seems to him to be the best indicator of the sensibility of the nervous system, and consequently of the relative systematic rank of the animal. His synopsis confirms the rule of Professor Agassiz, that land animals are more perfect than marine; but this rule may be explained in the sense that the divisions with the largest number of terrestrial forms always are the superior. The lowest class, Acephala, is entirely aquatic, and chiefly marine. There is also the same concordance with Professor Owen's law, that the multiplicity of organs indicates inferiority in organization. Thus the duplicity of the organs of Acephala descends as the system ascends.

M. Paul Rocher, in a paper brought before the Academy of Sciences, makes some interesting observations upon the manner in which terrestrial Mollusks obtain food under circumstances of extreme drought. Travelling in the south of the province of Oran, in Algeria, he had occasion to notice great numbers of them in the steppes of the desert, and proved that they derived the water necessary for their nourishment from certain of those succulent plants which grow spontaneously in arid situations, such as Atriplex halimus. This plant appears also to be the chief food of the Meah antelope, which, the Arabs say, lives several years without drinking. Another such plant is the Bou gerba, or bottle plant, upon which he has seen nearly every morning, while there was still some freshness in the air, hundreds of snails agglutinated. These Mollusks can exist for a long time without food, and are furnished, moreover, with a solid operculum, while the white colour, which appears to be characteristic of all the Saharian animals, defends them to a certain extent from the heat of the sun. Their shell also is relatively thick, for they all live upon the calcareous or saline plateaux of the desert, where they find abundance of material for the formation of their testaceous envelope.

Dr. Phipson, in 'Cosmos,' states that lately, being at Marburg, he observed, about 10 P.M., certain luminous insects flying in the air on the banks of the river. On securing one, he found it to be a male *Lampyris splendidula*, proving that the male Lampyri enjoy the faculty of emitting light, about which there was previously some doubt. But M. Schultze has described, more than a year ago, the structure of the luminous organs of these very same male insects, the tracheæ of which he finds to be terminated in a small cell of stellate form, which rapidly acquire a black tinge under the action of osmric acid, the cells of the parenchyma remaining uncoloured.

Dr. Walsh describes, in 'Silliman's Journal,' some very curious effects produced upon insects apparently by the material of their food, from which he is led to believe that otherwise identical insects differ, as varieties or species, according to the species of plant they feed upon. This difference of food may have very various results: sometimes it is accompanied by no difference whatever either in the larva, pupa, or imago state; but it may coincide with a marked difference in the colour of the silk-producing secretions, or a tendency towards the obliteration of the normal dark markings in the imago; or marked, but not perfectly constant, colorational differences in the larva, but none whatever in the imago; or by a marked and perfectly constant difference in the size of the imago; or by a marked difference in the chemical properties of the gall-producing secretions, the external character of the imago remaining identical; or by a slight but constant change in the coloration of the abdomen of the imago, and a very slight change in the chemical properties of the gall-producing secretions; or by one marked and perfectly constant colorational difference, and others which are not perfectly constant in the larva, but none whatever in the imago; or by several slight, but constant structural differences in the male imago, but none whatever in the female; or by a slight but constant structural difference in both male and female imago; or by very strong structural and colorational differences in the larva, and in all probability by a constant structural difference of generic value in the female imago, the males being to all external appearance identical, and the two insects belonging to different genera; or lastly, by marked and constant differences, either colorational or structural, or both, in the larva, pupa, or imago states. Of each of these he gives examples; and remarks that for his own part, as on the most careful consideration he is unable to draw any definite line in the above series, and to say with certainty that here end the varieties, and here begin the species, he is therefore irresistibly led to believe that the varieties gradually strengthen and become developed into species, and that the difference between them is merely one of mode and degree.

Professor Claus finds that in the Ostracode division of Crustacea, the heart is sometimes present and sometimes absent. This remarkable fact was demonstrated by the discovery of a heart beating with regular pulsations in *Cypridinæ*, while it is known that in the other two families, Cypridæ and Cytheridæ, the heart is absent. The same curious circumstances obtain in the Copepoda, of which the families Cyclopidæ, Harpactidæ, and Corycæida possess no heart, while in the other two families, Pontellidæ and Calanidæ, it is always present. M. Claus has also detected in the Cypridinæ, in addition to the large, paired, compound eye, an accessory single eye, simple and median, perfectly similar to that which exists in addition to the compound eye, in the Daphniæ. The Cypridinæ thus appear to differ widely from the other two Ostracode families, not only in these respects, but also as regards their appendages, the three anterior pairs of which are employed by them as locomotive organs, as is the case with all Entomostraca during their Nauplius phase.

It is very unfortunate that disputes should arise upon scientific questions to such a degree as that either disputant should indulge in personalities, but the scientific world has been of late anything but edified by the discussions between Dr. Carpenter and Professor William King of Belfast. The foraminiferous character of the fossil Eozöon canadense, distinctly asserted and minutely described by Dr. Carpenter, has been attacked by Dr. King, and much heat is introduced into the discussion. Another subject sets them also at variance, a matter of fact depending upon experience and acuteness of observation, *viz.* the microscopic structure of the shell of

Rhynchonella Geinitziana, which Dr. Carpenter describes as imperforate as regards the outer layer, while Professor King declares it to be perforated. Dr. Carpenter expresses himself fairly enough, as prepared to meet with perforated Rhynchonellidæ, although *imperforation* is the family character; but a careful examination with the binocular microscope and a magnifying power of 120 diameters upon transparent lamellæ and sections, makes him feel justified in reiterating his statement that the passages which are visible in the shell, traverse the internal layer only, and are therefore pits and not canals, while it appears that Professor King's observations have been made upon the exposed surfaces of his specimens, with a Stanhope lens only. It does certainly appear to us presumptuous, to say the least, in any observer to be content with such imperfect appliances and inadequate observation, to challenge with such boldness the results of so careful and trustworthy an observer as Dr. Carpenter. Inasmuch, however, as this is the third case of a similar kind in which Professor King has come into collision with Dr. Carpenter, we cannot help fearing it is the result of an antagonism which, for Professor King's reputation, is much to be regretted.

Dr. Beale states that the best way of studying muscular contraction is to examine the larva of the flesh fly. The movements continue for ten minutes or a quarter of an hour after the muscles are detached from a freshly killed larva, and in winter for as much as half-an-hour. The best way to see them is by polarized light, by the aid of a plate of crystallized gypsum. When the body colour is green, the waves of contraction which are propagated along each muscular fibre in different directions are of a brilliant purple. In other parts of the field the complementary colours are reversed. With very high powers, it is easy to observe the change which takes place in the contractile tissue itself, each time that it passes from the state of contraction to that of relaxation, and back again, and that for several minutes at a time.

Mr. H. L. Smith of Kenyon College describes in 'Silliman's Journal' an apparatus by means of which he keeps Diatomaceæ alive for a long time under the microscope, for the purpose of observing the phenomena of conjugation. It is a slide, which is a trifle more than an eighth of an inch in thickness, and consists of two rectangular glass plates, 3 inches by 2, and $\frac{1}{25}$th inch thick; separated by thin strips of glass of the same thickness, cemented to the interior opposed faces, thus forming a closed cell to be filled with water, and upon which the achromatic condenser can be brought to bear. A small hole is drilled through the upper plate, and one corner of the upper glass is removed. The space between the two plates is then to be filled with clean water by means of a pipette, a drop being placed upon the drilled hole to remove the air. The object being put on the top of the slide and wetted, is then to be covered with a large square of thin glass, which covers the drilled hole, and is prevented from slipping by a small strip cemented as a ledge under it. The slide can now be placed upright, or in any position, and no water can escape. As the water evaporates from under the cover, more is supplied through the hole, and from time to time an air bubble enters at the removed corner of the upper plate, so that a constant circulation is kept up. The cell needs replenishing only about once in three days, and this may be done without disturbing the object. It is in fact only a new application of the old principle of the bird fountain.

The science of Zoology has sustained great losses of late in the death of three eminent conchologists. The first of these was the well-known traveller and collector, Mr. Hugh Cuming, who had devoted many years to the investigation of the Natural History of South America and the Eastern Archipelago, where he gathered the richest collection ever brought home by a single traveller, which has rendered his cabinet of shells the most remarkable in Europe. We understand this collection has been offered to the British Museum for a sum of money much beneath its value, and has been accepted. The second conchologist whose loss we have to deplore, is Mr. S. P. Woodward, the author of the best manual of conchology we have. Mr. Woodward was engaged in the British Museum, and his knowledge of shells was most extensive. He had long suffered from an asthmatic affection, which finally carried him off. We have more lately lost an enterprising and learned conchologist in Mr. Lovell Reeve, whose "Conchologia Iconica" is his best monument, a work which, having reached fourteen or fifteen volumes, copiously illustrated, is nevertheless unfortunately far from being completed.

ANNUAL RETROSPECT.

The year 1865 has been characterized by slow, steady progress, rather than by any brilliant achievements in science, and if we were to look for striking events in the record of the past year, we should be met by failure and death, rather than by notable successes or the birth of genius.

The second failure of the attempt to lay the Atlantic cable, although the postponement of what appears to be a certain success, will serve to remind scientific men how slow and laborious must always be the conquest of the elements; and though we cannot say to the enterprising electricians, "go to the ant, thou sluggard," still we must point to the humble little spider, which spins and spins its line, failing again and again in reaching the desired point, until perseverance triumphs and the goal is attained.

And when we look at men instead of measures, how destructive do we find the scythe of time, or the ravages of disease, to have been during the past year. At once the names of Fitzroy, Hooker, Lindley, Falconer, Gratiolet, Silliman, Baikie, Tinné, Reeve, Woodward, Christy, and Waterton sound in our ears, and in every branch of science do we find a gap of greater or less proportions.

To the memory of one of these chiefly—namely, the first, do we desire to pay a special tribute of praise, and it is indeed a selfish feeling that prompts the distinction, for we feel that few men could have been spared with more serious consequences to their fellow-men. Already Admiral Fitzroy's researches in Meteorology, and his practical application of the science, had effected an amount of good which it is impossible to estimate. Who can say how many lives he saved? Who can tell how many more would have been spared had he continued to live? We have no wish to disparage the efforts of his successors who seek to follow in his wake: quite the reverse; we would have them profit by his example, and endeavour to develop the unfinished work of his life. But it is idle to attempt to hide the fact that his knowledge, acquired, no doubt, in a large degree by personal experience, has not survived him in its entirety, and that his followers must to a certain extent begin *de novo,* and repeat his experiences before they can even hope to attain his power of benefiting the seafaring man by forecasts of the weather.

We are hopeful, however, that the work which is being carried out over the large field of Europe, by Le Verrier, may lead to a more perfect knowledge of the laws by which the atmospheric currents are regulated, and thus place in our hands that kind of information which we require to guard us from the destructive violence of the winds. In connection with Meteorology, much interest attaches to the balloon ascents made by day and night by Mr. Glaisher. Although a large number of observations have been made with all the care possible under the circumstances, many more aërial journeys will be requisite before the numerous conditions connected with terrestrial radiation and the influences of heat and electricity on atmospheric phenomena can be recorded. Then it will still remain undetermined whether the results observed are constant or varying. We are gathering a large amount of knowledge in this branch of science, but we must be content to wait, never ceasing to work, for the development of the laws which shall embrace the apparently irregular phenomena with which we have to deal.

In this work it is the duty of all who are able to give any assistance, to render it cheerfully and zealously, and there is one phase of the subject to which semi-scientific or even unscientific observers of meteorological phenomena may with advantage direct their attention; we mean the measurement of the rainfall in their own particular localities. A committee, consisting of Mr. Glaisher, Lord Wrottesley, Professor Phillips, Professor Tyndall, Dr. Lee, Mr. Bateman, Mr. Mylne, and Mr. G. J. Symons has been appointed to collect information on this subject, and the last-named gentleman* has issued a circular to the press, in which he gives the localities and elevations at which, to the knowledge of the Committee, observations have been made since the year 1766, and asks for information on the subject of the British Rainfall from all who are willing to collect suitable data. No doubt there will be plenty of volunteers to provide the requisite information.

One point of great interest in connection with this of science appears to have been determined—namely, that the solar heat-rays pass through space without loss, and become effective only where wanted; and, in proportion to the density of the atmosphere or the amount of water present in that through which they pass. If it be so, the proportion of heat received at Mercury, Venus, Jupiter, and Saturn may be the same as that received at the Earth, notwithstanding their different distances from the sun.

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* Whose address is 136, Camden-road, London, N.W.

Many subjects of much interest in this division of science engaged the attention of the Physical section of the British Association; amongst others, a self-recording anemometer was exhibited by Mr. S. B. Howlett, and some of the records shown. This ingenious instrument appeared to indicate that even the light breezes of summer have a tendency to move in circles, or to describe longer or shorter ovals, in their course. We learn that this apparatus is being manufactured at a moderate cost, and hence we hope that ere another year passes by, we may be in a position to report its capabilities and indications when used on a more extended scale.

Although belonging to another division of Experimental Science, still, as having immediate relation to the above subjects, Professor Tyndall's researches on the Heat Spectrum, and especially on the phenomena to which he has given the name of *Calorescence*, must be regarded as of considerable importance.

In the history of this interesting inquiry, the researches of Herschel (the elder), of Schenck, and especially of Melloni, must not be forgotten. We would especially direct attention to Melloni's memoirs on '*A New Nomenclature for the Science of Calorific Radiations.*'* The application of prismatic analysis to the objects in the heavens has been continued with much success. Mr. W. Huggins appears to have proved the gaseity of the nebulæ, and thus to have restored, to some extent, confidence in the "nebulous fluid" of Sir W. Herschel, from which by subsidence and condensation stars are supposed to be elaborated. Father Secchi, from a careful examination of the spectrum of Jupiter, shows that the atmosphere of that planet has a peculiar and strong absorbing power, different from the atmosphere of the Earth. He thus advances towards the proof required by Mr. Glaisher's observations, that planets, according to their positions in space, are physically so constituted as to suffer nothing from any loss of solar heat or light.

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* 'Bibliothèque Universelle de Genève,' No. 70, for October, 1841. Translated in 'Scientific Memoirs,' vol. iii., part 12.

The question of the existence of an atmosphere in the Moon is re-opened by the fact observed by Mr. Huggins, that the *spectrum* of a star a little before and at the moment of its occultation by the dark limb of the Moon, exhibited several phenomena characteristic of the passage of the star's light through an atmosphere. The indications which will be found in our *Chronicles* of the advances of knowledge in this direction, by the aid of spectrum analysis and astronomical photography, would lead us to believe that many of our views respecting the conditions of planets and stars will receive considerable modification, if they are not destined to undergo an entire change. The solar photosphere and the solar spots have received a large share of the attention of astronomers. A great number of remarkable phenomena have been observed, but it would be premature to state that any positive facts had been determined. It is most satisfactory to know that the Hofrath Schwabe has given the Royal Astronomical Society his valuable collection of sun-drawings, and his solar observations from 1825 to the end of 1864. This, the most remarkable series of continuous observations ever made by a single man, has enabled us to determine the law of periodicity observed by the solar spots. The 'Researches on Solar Physics' by De la Rue, Stewart, and Loewy, of which the first series has recently been published, brings all the observations together, and thus greatly aids the inquiry. Professor John Phillips and Mr. Dawes have been directing their well-trained attention to the planet Mars. They are rendering us well acquainted with the physical features of that planet, and proving the repetition of many terrestrial phenomena upon it, showing, indeed, that the character of the climate of Mars is not very different from that of our great continents.

Passing from Astronomy and the applications of Chemistry to the necessities of that science, we must briefly remark on the progress made by chemists during 1865. The period has been one of considerable anxiety; to many, a period of transition is always so. The unmanageable names which the necessities of discoveries in organic chemistry have introduced, has rendered necessary the introduction of a more precise and satisfactory system of notation than that at present in use. There exists much difference of opinion upon this question. The discussions which have taken place have not produced anything approaching to uniformity in the notation of even modern chemists; while those of the older schools see nothing but confusion in the systems proposed—adopted—modified—and abandoned in succession. It is to be hoped that from amongst the ranks of our young chemists, many of whom exhibit great originality of thought and considerable mental power, some one will seriously undertake the task of reducing the overburthened system which is now adopted to a state of simplicity and order.

Investigations have been steadily carried forward in connection with the new and rare metals with which spectrum analysis made us acquainted; and new sources from which these metals can be obtained, have been discovered.

Mr. H. C. Sorby, with his usual ingenuity, has applied spectrum analysis to the Microscope, and has employed it in making some important investigations on the detection of blood-stains. Considerable advances have been made in determining the positions, numbers, and conditions of the dark lines in the solar spectrum and their agreement with the lines produced by known substances.

Much interest was excited by a published statement that *antozone* had been isolated by Schönbein, and the compound condition of oxygen determined. This has not been done; indeed the existence of such a body as antozone is somewhat problematical. It is, however, satisfactory to see that the evidence on the peculiarities and properties of ozone are accumulating, and proving this allotropic state of oxygen to be of high importance in the economy of nature.

Inorganic chemistry has discovered several new minerals, and many inquiries of much practical importance have been carried out.

Weil, by his simple process of coating one metal with another, without the aid of a voltaic battery, has introduced a process which must greatly extend the advantages of electro-metallurgy.

Deville and Troost, by their discovery of the permeability of certain dense metals at elevated temperatures to gases, have opened a most curious inquiry on the boundary line between physics and chemistry. Deville's experiments on the phenomena of *dissociation*, or the partial decomposition of compound gases under the influence of temperatures more or less elevated, have been continued with many important results, and lead, or are leading, to an explanation of some of the anomalies which have hitherto beset the laws of gaseous volumes, and the molecular theories of their constitution.

Gun-cotton, nitro-glycerine, and several new gunpowders have been submitted to trial by practical men, with, as reported, very variable advantages. Gale's process for rendering gunpowder non-explosive for stowage and transport has been taken up by a public company; but we believe it has not been applied on the large scale. Its real value has, therefore, yet to be determined.

Mr. Crookes's new and interesting process of increasing the amalgamating power of mercury by the aid of sodium has been rendered free from any of the objections which at first stood in the way of its adoption, and is now employed with much success and economy.

Organic Chemistry still advances in the direction of those synthetical proofs of transformations which constitute its most striking feature. The researches of Frankland and Duppa, and of several of the German chemists, are progressing towards that "grand conception," which seems to inspire Dr. Hofmann, "of a natural classification of chemical bodies into genera and species, each distinguished by well-marked characteristics, not excluding individual varieties, but grouping them in subordination to collective laws."

The value of chemical inquiry becomes most apparent when it is skilfully applied to the improvement of manufactures, or to the removal of the injurious effects arising from them. In the first Annual Report of Dr. Angus Smith, the Inspector under the Alkali Act, we have satisfactory evidence of this. The whole question of the condensation of noxious gases is fully dealt with, and if Dr. Angus Smith's knowledge as applied to this end, is only seconded by the attention of the manufacturer, all cause of complaint will speedily be removed from the alkali manufacture.

Chemistry is naturally allied to metallurgy, and we find during the year considerable evidence of the activity with which experiments have been made to improve the processes or their results. Iron has especially claimed the attention of the French chemists, and some promising results have been reported. Experience shows that we are steadily advancing towards the conversion of iron directly into cast steel, by other and more, strictly speaking, chemical processes than those now in use.

Puddling, although a mechanical process, is in its results, as nearly every metallurgical process is, a chemical one. The application of machinery, to produce the proper oxidation of the carbon in the iron, has been extended and improved. We hear, however, of large experiments which promise results superior to any which have yet been obtained, in the production of merchant iron.

One of the most important improvements which have been introduced, is the utilization of the copper-smoke of the great copper-smelting establishments of Swansea. That which has been for many years a great nuisance to the neighbourhood, and by which vegetation has been destroyed for many miles around the works, is, at the establishment of the Messrs. Vivian and Sons, now converted into sulphuric acid, an article of commercial value.

Metallurgy is directly dependent, for the material upon which it operates, on Mining. Our journal shows that science has been called in to aid in removing those evils which surround a life of subterranean toil, and by which the miner perishes in the prime of life. The Mines Commission in their Report have proved, upon the evidence of the most accomplished experimentalists, that the air of our metalliferous mines is seldom in such a state as will ensure the continuance of health. An attempt was made by Lord Kinnaird to pass an Act to regulate the conditions under which our metal mines are worked. His lordship was induced by the Government to withdraw the bill which he introduced, but this was followed by the production of a second bill, somewhat modified, which will come under the consideration of the House of Lords early in the ensuing session.

The application of the law of the diffusion of gases to the detection of fire-damp in collieries has been experimented on, upon a large scale, in the Hetton collieries.* The instrument invented by Mr. Ansell, of the Royal Mint, has answered most completely. We learn that a continued series of experiments is about to be made, even if they are not now in progress, in the fiery collieries of the South Yorkshire district.

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* While these pages have been passing through the press, the chief proprietor of these collieries, Mr. Nicholas Wood, F.R.S., has been removed from among us. Mr. Nicholas Wood has ever been the promoter of scientific applications to the necessities of colliery operations. He belonged to a group of superior men, being the friend and associate of Stephenson and of Buddle. His loss is a severe one to the Newcastle district.

The continuation of the production of gold from the quartz veins of the Welsh mountains is giving the promise of a return for the large expenditure which has been made. The settlement of the war in America has led to an advance in the price of tin, and the blockade of the Chilian ports has produced the same effect on copper, so that peace on one hand, and war on the other, are equally benefiting the British miner.

Attention having been drawn to the value of the bituminous shales, sandstones, and clays, we find that these sources of "mineral oil" are discovered in every quarter of the globe. The experiments on the use of petroleum as a fuel for steam boilers appears to have been thoroughly successful. Therefore we may expect that the large supplies of the material promised will be required to meet the new demand. The most remarkable discovery of mineral treasure recently made, appears to be that of silver in the Nevada territory, where a new Potosi is actually developing its treasures.

Agriculture has been seeking the aid of the sciences for its improvement. It has been proved that sewage manure has a remarkable fertilizing effect upon some grass lands; judgment is, however, required in its application, but with that judgment we hope we shall not be much longer subject to the rebuke of annually pouring into the sea at Barking 100,000,000 tons of food-producing material.

The want of calculation, of forethought, on the part of men has been strikingly shown by the ill-judged extension of the drainage of land. The rain falls on the land, and in a few hours it has been carried off by the rivers to the sea; consequently, when a short period of dry weather supervenes, the farmer finds his crops perish through the want of water. Irrigation, therefore, has all at once become the question of the hour, and we find the Agricultural Society of England pressing the subject upon the farmer by the assistance of their chemist, Dr. Voelcker.

There is a continued earnest desire on the part of our leading agriculturists to extend the benefits of professional agricultural education by the establishment of clubs, schools, and colleges devoted to practical agriculture.

The value of scientific education is becoming more evidently felt, and the science classes established in connection with the Science and Art Department are proving the beneficial results of the system. That the Liverpool Town Council has re-established scientific lectures is another evidence of the growing feeling that, in a manufacturing kingdom, science has a real money value.

The want of this knowledge has been most forcibly thrust upon our attention by the cattle plague. It comes upon us, as came the cholera, when we are entirely unprepared to receive it, and our cattle doctors stare at each other in their wretched ignorance, write bald letters to the daily journals, and seek to bury the evidences of their own stupidity in the free use of the poleaxe! In the meantime, the cattle-feeder and the dairyman are left to the tender mercies of the most impudent pretenders. In future years, this period of difficulty will be spoken of as one marking the blind ignorance of a people who boasted of the march of intellect, but who had, in many respects, fallen sadly into the rear. Now that the disease has spread over the length and breadth of the land, men are beginning to study its pathology.

Sanitary science slowly makes itself felt, yet, curiously enough, with the evidence of its advantages in the preservation of health and the improvement of the people which have been brought under its influence, many bodies of men stoutly resist what they are pleased to call its interference. Many of our large towns—especially Liverpool, Glasgow, Manchester, and Leeds—still remain in a most disgraceful state, and villages, singularly picturesque when "distance lends enchantment to the view," are foul and offensive as you approach them. Many of these are now found to be, instead of the homes of health and rosy cheeks, well-devised nurseries of fever. The Social Science meeting of this year drew attention to many of those evils, physical and moral, and the discussions which arose on many of the questions cannot be without their influence for good. No doubt, there are many things comprehended under the singularly expansive title of sanitary science which have little claim to attention, and which serve only to create a smile. Numerous hobbies are ridden with desperate energy on the occasion of these meetings—regarding these, however, as the waste and useless steam blown off, a large reserve of power is left, which can be advantageously applied.

The means of communicating between the guard and the passengers in railway trains has received much attention during the year, but with very slight advantage. On the South-Western Railway an experiment has been fairly tried, with, we believe, evident advantage to all concerned. But railway boards are evidently possessed with the genius of procrastination, and are ever postponing the consideration of improvements, until they are forced upon them by the uncontrollable impetuosity of a public outcry, excited by some frightful accident or other.

To return to the natural sciences, Geology has something to report. It has proved the existence of life in the world during geological ages which have been considered, as it regards organization, a blank, and to which the term of *azoic* (void of life) has been given. Long previous to the origin of the Silurian and Cambrian strata, which were regarded as the oldest sedimentary formations, vast masses of rock had been accumulating in the ancient seas. These have been detected by Sir William Logan in the Laurentian chain of Canada, and by Sir Roderick Murchison in the ancient rocks of the north of Scotland, to which the name of Fundamental Gneiss was given. The Laurentian rocks of Canada contain a zoophyte, the *Eozoon Canadense,* which is certainly the most ancient organization known to exist. The discovery of this Foraminifer in the lowest known deposit confirms the doctrine that the lowest animals alone occur in the earliest zone of life, and that this beginning was followed through long periods by creations of higher and higher animals successively. The evidence is before us, that through the prolonged periods comprehended within the Lower Silurian epoch, no vertebrate animal has been discovered. Fishes begin to appear in the Upper Silurian zone, and they have been continued to the present day. New forms of vertebrate animals have succeeded each other as we ascend in the scale, until in the overlying Secondary and Tertiary formations, higher and higher grades of animals appear, the relics of man or his works having been discovered in the youngest of the Tertiary deposits.

The geologist and the archæologist have here points of contact. The discovery of the rude works of early races of men in drift deposits and in limestone caves, associated with the remains of animals which no longer exist, unmistakably shows the age of man far back in time. This interesting question is not, however, to be regarded as a settled one. Even the best authorities see reasons for holding these hypotheses loosely, hoping that extended researches may clear up many points which now remain obscure or doubtful.

The divisions of a Stone Age and a Bronze Age have been questioned. Mr. Wright is disposed to believe that all bronzes are Roman, and that the use of stone implements and weapons may have been continued, by the untrained tribes inhabiting a country, at the very time when the more cultivated inhabitants of cities were manufacturing both bronze and iron into articles for use or ornament.

The discovery of flint implements in every part of Europe and in the East proves, not as some have supposed, the extension of the same races of men, but rather that pre-historic man, of every race, when he was compelled by his necessities to employ his mind in the production of tools, chose stones at first, as they were most conveniently at hand. The selection of such as were best fitted for cutting instruments, or for delivering a blow, would be the next stage of development.

Geographical Science has been active, and many of our enterprizing travellers have added largely to our knowledge of the Earth's surface. Vâmbéry brings us fresh information from the lands rendered interesting to us all as the scene of the exploits of Timour Khan, and over which travelled our ancient friend Marco Paulo.

The Geographical Society, urged on chiefly by the suggestions of Captain Sherard Osborn, has been occupied with considerations of a new Arctic expedition. Though earnestly advocated by the President and many influential members of the Geographical Society, the question of another expedition has not received any encouragement from the Government, owing, no doubt, to the dangers that beset it, and which have already been fatal to so many brave men. In the meantime, Mr. Hall is dwelling amongst the Esquimaux. He is said to have found Franklin's ships, and he is following up a track which he hopes may lead to more important discoveries

An important work has been carried out through the agency of the officers of our Ordnance Trigonometrical Survey. Sir Henry James, R.E., directed a survey of Jerusalem and of the Dead Sea to be made by Captain Wilson, R.E., and a party of Sappers under him. This has been carefully done, and the true condition of the

Dead Sea relative to the Mediterranean has been set at rest. Much progress has been made towards raising the fund necessary for a complete survey of the Holy Land. It is contemplated, if money enough for the work can be obtained, to place each special subject in the hands of well-known men, and thus ensure the best possible information on the Archeology, Geology, Geography, History, Zoology, Botany, and Meteorology of this interesting region.

In African exploration we have to record the failure of the East African expedition, under Baron C. von der Decken, and that of Du Chaillu in the West. At the same time we have the satisfaction of having Mr. S. W. Baker amongst us, the discoverer of a vast lake, the Albert Nyanzà, "a limitless sheet of blue water, sunk low in a vast depression of the country." The western shore, some sixty miles distant from Mr. Baker's place of observation, consisted of a range of mountains, 7,000 feet in height. There is no doubt but that this lake and the Victoria Nyanza of Speke and Grant are the great reservoirs of the Nile.

Of Mr. Palgrave's interesting journeys in Arabia full mention has been made in the Geographical Chronicles of this journal, and we must now in conclusion add a few brief words on the subject of Natural History.

A record of Zoological progress will be found in another portion of this number, and as far as the application of Zoology and Botany to the Arts is concerned, there is but little of interest to be noted. Of the most vital importance to man are the efforts being made, and we are happy to say successfully, to cultivate the Cinchona plant in India. The plantations on the Neilgherries are thriving beyond expectation, and a large supply of quinine may doubtless be looked for from this source. And the successful cultivation of this useful plant in one of our colonies is an unanswerable argument in favour of further researches in all our colonies on the subject of their floras generally. These researches have been pushed forward most vigorously of late by Dr. Grisebach in the British West Indies, by Bentham and Müller in Australia, by Dr. G. Lawson in Canada, and Dr. Hooker in New Zealand. Indeed, if there be one lesson more than another that an enterprizing people should lay to heart, it is that they should not judge hastily which of their colonies are useful, and which are not. The only justification that a nation such as we are, can find for having extended our conquests far and wide, is that it enables our civilizing influence to be felt in savage lands, and our cultivating care in waste places; and it cannot be too strongly urged upon our Government that their first duty abroad is to turn to good account all the products of nature, and to give employment to the intelligent pioneers of every branch of science. Much good has been rendered to Zoological science by Mr. H. B. Tristram, who has made an extensive collection of animals in Palestine, which have afforded work for some of our leading zoologists at home; indeed, it seems surprising that the fauna of a country rendered so interesting by tradition should have been so little known in Great Britain.

And now the mention of Zoology and tradition will, no doubt, have suggested to many of our readers that delicate problem, the Origin of Species, and consequently the Origin of Man. Although to the unscientific world it may appear that the whole question slumbers, this is far from being the case. Day by day new evidence is adduced either for or against the theory of natural selection and the transmutation of species; and surely, but silently, a revolution is taking place in the method of recording natural history.

That silence we shall not at present attempt to break; for it is as essential to the progress of knowledge and to the attainment of truth as are the hidden processes which are going on in the secret places of nature, or in the closed workshops of art, before the new life can be revealed, or the finished work exhibited. But we feel bound to say a few words concerning some of the means now adopted to attempt the elucidation of the most interesting and difficult problem of the day—namely, the origin and development of man. We have at the present time in London two competing societies, publishing two competing journals, both of which, under different titles—the 'Ethnological' and the 'Anthropological'—profess themselves anxious to throw light upon this obscure and warmly-debated subject. A glance at the proceedings of these two societies would lead the unprejudiced observer to form rather a humble estimate of the efforts of science in this direction, for it is hardly possible to be present at their meetings, or to peruse a Number of the respective journals, without at once perceiving that one of the most serious and important scientific questions of the day is being treated, to speak mildly, in a sensational rather than a rational and legitimate manner. Whichever way we turn, we are met by personal recrimination, bad puns, exhibitions of vanity, and anything but the evidences that man is a reflecting, reasoning creature. We are not going to condemn utterly either the Anthropological or the Ethnological Society. To judge from the account given in the 'Ethnological Journal' of the establishment of the 'Anthropological,' we feel convinced, although the writer of the article thinks otherwise, that a new society was to some extent a necessity of the "situation;" but when we turn to the 'Anthropological Journal,' or consider the mode in which its officers seek to attract public attention, we find with regret that the need has not been supplied in a manner worthy of this great nation. Just imagine two large societies, reckoning amongst their members some of the leading investigators of the day, established for the purpose of elucidating their own human nature and the history of their race, calling each other names, and squabbling like a couple of schoolboys whether this or that one has a right to say aloud the lesson which both are just beginning to learn!

There is ample room for both societies to investigate the origin and nature of man, and other germane subjects, and we should not be surprised to see established, before long, a third society, which would certainly succeed if it sought to combine the modest, moderate, and self-sacrificing men of both parties.

What appears to us to be needed for the elucidation of the subject, is not a medley of desultory papers on the negro, cannibalism, anthropology, philology, and so forth, but a well-devised programme or scheme, somewhat of the nature of a commission, which shall bring together all relevant facts; sift and prune, suggest and search; until we shall have presented to us, an uncoloured and accurate, though it may be at present an imperfect outline of the rise, development, and present condition of the human race throughout the world. There are men of science living who are well qualified to co-operate in such a labour, but for the reasons already assigned, they hold aloof from the controversy, and are content to wait for the return of calm judgment and courtesy into the councils of anthropological or ethnological science.

A new year now dawns upon us, a year that may be barren of incident, or pregnant with important revelations, and one that will assuredly be too short for every earnest student of Science; for all who seek to place her in her legitimate rank in civilization and religion.

Let us, then, not wrangle about words, nor seek to elbow our way into a higher seat than our neighbours, lest we find ourselves in the lowest seat of all; but giving without stint of the knowledge that is so freely given to us, let us diligently and hopefully continue our search after Truth.

Quarterly List of Publications received for Review.

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1. Introduction to Modern Chemistry, Experimental and Theoretic. Embodying Twelve Lectures delivered in the Royal College of Chemistry, London. By A. W. Hofmann, LL.D., F.R.S., V.P.C.S., Professor of Chemistry in the Royal School of Mines, &c. &c. 65 *Woodcuts.* 250 pp. Post 8vo. *Walton & Maberly.*
2. On the Combining Power of Atoms. By A. W. Hofmann, LL.D., F.R.S. 30 pp. Demy 8vo. *From the Author.*
3. The Record of Zoological Literature. 1864. Vol. I. Edited by Dr. Günther, M.A., F.Z.S., &c. 640 pp. Demy 8vo. *Van Voorst.*
4. Treatise on Iron Ship-building: its History and Progress, as comprised in a Series of Experimental Researches on the Laws of Strain; the Strengths, Forms, and other Conditions of the Material; and an Inquiry into the Present and Prospective State of the Navy, including the Experimental Results on the Resisting Powers of Armour Plates and Shot at high Velocities. By Wm. Fairbairn, C.E., LL.D., F.R.S. With 126 *Engravings.* 350 pp. Demy 8vo. *Longman & Co.*
5. On some Physical Effects produced by the Contact of a Hydrogen Flame with various Bodies. By W. F. Barrett, Assistant in the Physical Laboratory of the Royal Institution. 9 pp. 8vo. *From the Author.*
6. Researches on Solar Physics. By Warren De la Rue, Ph.D., F.R.S., Balfour Stewart, F.R.S., Superintendent of the Kew Observatory, and Benjamin Loewy, Observer and Computer to the Kew Observatory. First Series. On the Nature of Sunspots. 33 pp. Royal 4to. *From the Authors.*
7. Handbook of Geological Terms. Geology and Physical Geography. By David Page, F.R.S.E., F.G.S. Second edition. 500 pp. Crown 8vo. *Blackwood & Sons.*
8. On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life. By Charles Darwin, M.A., F.R.S. Third edition. 550 pp. Post 8vo. *John Murray.*

9. On the various Contrivances by which British and Foreign Orchids are fertilized by Insects, and on the good Effects of Intercrossing. By Charles Darwin, M.A., F.R.S. With 34 *Wood-engravings.* 370 pp. Post 8vo. *John Murray.*

10. Journal of Researches into the Natural History and Geology of the Countries visited during the Voyage of H.M.S. 'Beagle' round the World. By Charles Darwin, M.A., F.R.S. Tenth thousand. 530 pp. Post 8vo. *John Murray.*

11. On the Movements and Habits of Climbing Plants. By Charles Darwin, F.R.S., F.L.S. 1865. Taylor & Francis. *From the Author.*

12. Report of the United States Patent Office for 1862. 2 vols. Vol. I. Text; Vol. II. Plates. *Washington Government Printing Office.*

13. Contributions to Blowpipe Analysis. By E. J. Chapman, Ph D., Professor of Mineralogy and Geology in University College, Toronto. 20 pp. Demy 8vo. *From the Author.*

14. Cholera Prospects; compiled from Personal Observation in the East, for the Information and Guidance of Individuals and Governments. By Tilbury Fox, M.D. Lond. 40 pp. Demy 8vo. *Hardwicke.*

15. A Treatise on Smoky Chimneys, their Cure and Prevention. By Frederick Edwards, jun. Second Edition, *with Plates.* 40 pp. Demy 8vo. *R. Hardwicke.*

16. Our Domestic Fireplaces; a Treatise on the Economical Use of Fuel and the Prevention of Smoke; with Observations on the Patent Laws. By Frederick Edwards, jun. Second Edition, *with Plates.* 110 pp. Royal 8vo. *R. Hardwicke.*

17. Inorganic Chemistry for Science Classes. By Fearnside Hudson, F.C.S., Government Certificated Science Master, Manchester. 200 pp. Crown 8vo. *From the Author.*

18. Seven Lectures on Scripture and Science. By John Eliot Howard, F.L.S. 240 pp. Crown 8vo. *Groombridge & Sons.*

19. Catalogue of Works on the Microscope and of those referring to Microscopical Subjects in the Library of Freeman C. S. Roper, F.L.S., F.G.S., F.Z.S., &c. Printed for private circulation. *Adlard,* 1865.

PAMPHLETS.

On Chemical Reactions obtained by employing Anhydrous Liquids as Solvents, By G. Gore, F.R.S.

Proceedings of the British Pharmaceutical Conference. Birmingham Meeting, 1865. 90 pp. Demy 8vo. *From the Conference.*

Bulletin Mensuel de la Société Impériale Zoologique d'Acclimatation. Aug., Sept., Oct. *Masson & Fils.*

Rinderpest, its Prevention and Cure; and Gypsum as a Sanitary Agent. *Edinburgh: W. P. Nimmo.*

Revue Universelle des Mines, de la Métallurgie, &c. *Paris and Liege: Noblet & Baudry.*

A Dictionary of Science, Literature, and Art. Edited by W. T. Brande, D.C.L., F.R.S., and the Rev. Geo. W. Cox, M.A. Parts VI., VII., VIII. *Longmans & Co.*

Geological Magazine: Oct., Nov., Dec. *Longmans & Co.*

The Production and Preservation of Lakes by Ice Action. By Thomas Belt. 8 pp. Demy 8vo. *From the Author.*

Westminster Review: October. *Trübner & Co.*

Report of the Health of Liverpool. Sept. 2, 1865. By W. S. Trench, M.D., Medical Officer of Health, Liverpool.

Canadian Naturalist and Geologist: August. *Montreal: Dawson Brothers.*

Scientific Review: Nov. and Dec. *Cassell, Petter, & Galpin.*

Ethnological Journal: October, November. *Trübner & Co.*

Proceedings of the Royal Society.
„ „ Royal Astronomical Society.
„ „ Royal Geographical Society.
„ „ Chemical Society of London.
„ „ Geological Society of London.
„ „ Zoological Society of London.

London: Printed by W. Clowes & Sons, Stamford Street and Charing Cross.

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